AKENTEN APPIAH-MENKAH UNIVERSITY OF SKILLS TRAINING AND ENTREPRENEURIAL DEVELOPMENT

EFFECTS OF PEER TUTORING AMONG MATHEMATICS TEACHERS ON TEACHERS' EFFICACY, TEACHER QUALITY AND STUDENTS' ACADEMIC PERFORMANCE

KING SOLOMON NARTEY

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DECLARATION

STUDENT'S DECLARATION

I, KING SOLOMON NARTEY**,** declare that this thesis, except for quotations and references contained in published works which have all been identified and duly acknowledged, is entirely my original work, and it has not been submitted, either in part or whole, for another degree elsewhere.

SIGNATURE:…… **DATE**: ……

SUPERVISOR'S DECLARATION

We hereby declare that the preparation and presentation of this work were supervised in accordance with the guidelines for supervision of thesis as laid down by the Akenten Appiah-Menka University of Skills Training and Entrepreneurial Development, Kumasi.

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DEDICATION

This thesis is dedicated to my wife, Diana Dansowaah, whose unwavering support and encouragement have been my constant source of strength. To my dear sister, Rose Noble Nartey, your belief in my abilities has always pushed me forward. This thesis stands as a tribute to your love and belief in me.

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ABSTR ACT

The main purpose of the study was to investigate the impact of peer tutoring among teachers on teacher efficacy, teacher quality, and the academic achievement of students in the senior high schools. The target population of the study were teachers and students of all Senior High schools in the Ejisu Municipality. The study adopted an explanatory sequential mixed method approach. Purposive sampling aided in selecting eight (8) teachers for interview to gain insight into peer tutoring among mathematics teachers. Convenient sampling was used in selecting one hundred (100) teachers including the eight who did the interview for the regression analysis of the quantitative data. The study also used purposive sampling to select sixty-two (62) students to test the effect of the peer tutoring programme on students' achievement using independent t-test to compare the means of the pre-test and post-test. Teachers' perception of peer teaching among mathematics teachers was significant. The impact of peer teaching among mathematics teachers on teacher efficacy was seen as significant. The impact of peer teaching among mathematics teachers on teacher quality was seen as significant. The effect of peer tutoring on students' achievement in mathematics was significant. Mathematics Head of Department (HOD) of all senior high schools are encouraged to organize in-service training for teachers in the form of peer tutoring among mathematics teachers. It was further recommended that mathematics teachers should be motivated to engage in peer tutoring among themselves.

CHAPTER ONE

INTRODUCTION

1.0 Overview

In this chapter, the background to the study, the statement of the problem, purpose and objectives, research questions, significance of the study, delimitations and the general layout of the report as well as operational definitions of terms have been presented.

1.1 Background of the Study

In Ghana, mathematics education has faced challenges, resulting in low performance among students. Ghana's performance in mathematics needs attention, according to statistics at hand at some examination authorities such as the West Africa Examination Council (WAEC) and Trends in Mathematics and Science Study (TIMSS) (Amoako Atta, Asiedu-Addo & Asemani., 2023). Ghana's achievement in mathematics is nothing to write home about. Ghana scored horribly in math, science, and English tests, according to the Organization for Economic Cooperation and Development's (OECD) 2017 Education at Glance (EAG) (Zou, 2019). Some factors contributing to this issue include teacher quality and teacher self-efficacy. The teacher therefore assumes a significant role in the educational system. The teaching strategies they adopt in engaging students play a fundamental role in the comprehension and use of mathematical ideas (Arends, Winnaar & Mosimege, 2017). Teacher classroom practices are intended to increase learning; However, depending on the level of effectiveness of these classroom practices, this may or may not be achieved (Leithwood & Jantzi, 2006). According to Coe, Aloisi, Higgins & Major (2014), effective teaching is an activity that raises student achievement through the use of outcomes that are important to the students' long-term success. They contend that student growth must be

taken into account when determining the effectiveness of a lesson plan. They add that measuring instructional effectiveness versus student growth is necessary to determine whether it is effective or not. Clarity of presentation and well-structured lessons, among others, are the classroom practices that have proven to have positive effects on students' achievement (OECD, 2009). Teacher effectiveness is described by Tschannen-Moran, Woolfolk Hoy & Hoy, (1998) as the teacher's confidence in his or her capacity to plan and carry out the necessary steps to successfully complete a certain educational assignment in a particular situation.

Also, according to Donohoo (2017), as cited by Salas-Rodríguez and Lara (2023), teacher self-efficacy is defined as the belief that teachers hold with respect to their ability to effect change and impact the achievement of their students. It has been acknowledged that teacher efficacy is a factor that explains individual variances in teaching effectiveness (Gibson & Dembo, 1984) and has a significant impact on students' learning and success. (Cantrell, Young, & Moore, 2003; Ross, 1998; Gibson & Dembo, 1984). In a study by Chang (2015), he found that having a successful teaching career fosters a strong, positive belief in a mathematics teacher's ability, which in turn raises expectations for future proficiency. He also contends that effective teaching practices, which are in part supported by instructors' efficacy belief levels, are likely to have an impact on students' successful learning outcomes in mathematics.

According to Chang (2015), mathematics education professionals should make significant efforts to provide a supportive and cooperative working and on-the-job learning environment that fosters mathematics teacher efficacy. It is widely accepted that enhancing teacher quality is a crucial component in raising the quality of basic

and high school education (Harris & Sass, 2011). In the United States, having a "highly qualified teacher" in each classroom has been the major objective of recent administrations (Harris & Sass, 2011). According to Ambusaidi and Yang (2019), home environment and teacher quality are two factors that have a significant impact on pupils' success in school, according to a wealth of studies. This has generated debate over the most appropriate way to enhance teacher quality in both new and existing teachers.

According to Ambusaidi and Yang (2019), most pedagogues and policymakers are often not in agreement over the definition of teacher quality - it's interpretation and it's evaluation and it's use. They posit that two areas have typically been examined by researchers and policymakers to describe teacher quality. These are teacher inputs and classroom effectiveness. Heck (2007) described teacher inputs as teacher traits, professional preparation, and license, and described classroom success as students' results on standardized tests. Harris and Sass (2011) considered the connection between teacher effectiveness and teacher training, which includes formal university education, in-service training, and informal training received by way of work experience.

In this study, the researcher considered student achievement (teacher effectiveness), teacher training (through peer tutoring among teachers), and teacher practices as determinants of teacher quality.

In a collection of 12 pieces that discussed how creating a cooperative atmosphere at the school is a requirement for its own growth by McLaughlin and Marsh (1978), Judith Warren Little, author of "*Teacher as colleagues"* makes the argument that some studies provide vivid portrayals of the benefits to the classroom that result from instructors' collaboration. When celebrating their success, teachers who have collaborated closely

over many years highlight improvements in students' academic performance, conduct, and attitude. This suggests that there are more advantages to instructors collaborating together than to them working alone. According to Vygotsky (1978), communication and social interaction are essential for learning. He also emphasized that cooperative learning strategies are a crucial component of the process that results in the social creation of knowledge. One of the teaching methods that has received the greatest attention in the discipline of cooperative learning is peer teaching.

Peer tutoring has been shown to be a successful approach for energizing pupils and fostering their academic achievement (Lazarus, 2014). Peer teaching mathematics was studied by Vasay (2010), who discovered that it has a significant impact on learners' psychological and moral values, including their capacity for expression, understanding of various concepts, time management, sense of accountability, sharing, self-discipline, independence, self-confidence, creativity, teamwork, and obedience.

According to a study by Oloo, Stanley, Mutsotso, Edwin, & Masibo (2016), a larger proportion of students believed that the assistance they received from their classmates the previous term helped them improve their grade in mathematics. The students claimed that their understanding and retention improve when they impart knowledge to one another in group conversations. Various studies have proven significant for students, and findings showed that there was an improved attitude, motivation and self-esteem among students. Developing social skills and/or resolving social issues, teamwork enhancement, students learning to work as a unit to achieve the ideal individual objectives at the conclusion of their course, leadership quality and group supervision, a positive outlook on work, and the development of interpersonal and

speaking skills are a few of the the advantages. These benefits can be seen in teachers when they have peer teaching and learning among themselves (Oloo et al., 2016).

1.2 Statement of Problem

Students in various countries do not like mathematics (Thomson, Wernert, O 'grady, & Rodrigues, 2015); they see the subject as difficult or boring (Fritz, Butterworth, Haase & Räsänen, 2019; Moyer, Robison, & Cai, 2018). Math performance scores among SHS students are consistently low (WAEC, 2016 and 2018). According to the Chief Examiner's Report for the 2021 WASSCE Exam compared to the 2020 WASSCE Exam, math proficiency among students has decreased by eleven percent (11%) so that 65.71% had grades from A1 to C6 in 2020 and 54.11% in 2021 (WAEC, 2021). Beswick and Fraser (2019) attribute this low performance to the methodologies used and the way mathematics is presented to students by teachers. Some studies have shown that teacher quality (Arthur, Boadu, & Asare, 2022; Bonney, Amoah, Micah, Ahiamenyo, & Lemaire, 2015) and teacher efficacy (Perera & John, 2020) have an impact on students' academic performance. Teacher quality and teacher efficacy of mathematics teachers in Ghana may be improved through training for in-service teachers (Coffie, 2020; Hervie & Winful, 2019). In Ghana, most teachers have relied on the Ghana Education Service (GES) to organise in-service trainings for the enhancement of their skills and teaching methodologies; unfortunately, these trainings are also not forthcoming (Donkor & Banki, 2017). This has led to many teachers still using obsolete methods that are not bringing out the maximum in their students' output in the learning of mathematics. In the few that have been organised, according to Asare et al. (2012), the use of peer teaching during in-service training for Ghanaian teachers

was less popular, but rather the lecture method as a mode of delivery was predominantly used. This, according to them, did not foster the consolidation of new skills.

A lot of research has been done in the area of peer teaching among students. Defeo, Mammo, & Tran (2022) did a study on the effects of peer tutoring on self-efficacy. Arthur et al., 2022 and Sallah, Owusu, Narh-kert and Yawson (2023) did a study on the effect of peer tutoring on students' academic performance, but little has been done in the area of peer teaching among mathematics teachers in Ghana. The researcher in this study seeks to find out if peer tutoring among teachers has an impact on teacher efficacy, teacher quality, and the academic achievement of students in senior high schools.

1.3 Purpose of the Study

This study seeks to investigate the impact of peer teaching among teachers (in the area of subject matter knowledge and pedagogical skills) on students' academic performance in senior high schools. In addition to looking at how peer teaching affects students' academic achievement, the study also aims to discover if any other desirable traits (teacher efficacy and teacher quality) may be created among instructors themselves.

The purpose of the study can be achieved by achieving the following specific objectives:

1. To explore mathematics teachers' perceptions of peer teaching among mathematics teachers.
2. To investigate whether peer tutoring among mathematics teachers has an impact on teacher efficacy.

3. To explore the effect of peer tutoring among mathematics teachers on teacher quality.
4. To determine if peer tutoring among mathematics students has an impact on students' academic performance in mathematics.

1.4 Research Questions

The following are the questions that will direct the study:

1. What are mathematics teachers' perceptions of peer teaching among mathematics teachers?
2. How does peer teaching among mathematics teachers impact teacher efficacy?
3. How does peer teaching among mathematics teachers affect teacher quality?
4. What effects does peer teaching among mathematics teachers have on students' academic performance in mathematics?

1.5 Significance of the Study

The study is expected to assist teachers in engaging in cooperative learning (peer tutoring) to enhance their teaching pedagogy and also discuss subject matter-related challenges to make lesson delivery easier and more interesting, thereby enhancing teacher efficacy among mathematics teachers. Again, the study is expected to improve students' academic performance in mathematics as a result of the enhancement of teaching pedagogy and subject matter-related challenges. This study will serve as a source of reference for others who will be researching teachers engaging in cooperative learning to improve students' academic performance.

1.6 Delimitation of the Study

The study was limited to Achinakrom Senior High School and Onwe Senior High School in the Ejisu Municipality in the Ashanti Region of Ghana. It was restricted to peer tutoring among mathematics teachers to improve teacher efficacy and their students' academic performance. The findings were therefore limited to the teachers and students of Achinakrom Senior High School and Onwe Senior High School.

1.7 Organization of the Study

There are five (5) chapters in this study. Introduction, study background, problem statement, study objective, research questions, purpose of the study, significance of the study, study restrictions, and study organisation are all covered in Chapter 1. The literature review is covered in the second chapter. In chapter three, the methodology is discussed along with the research design, population, sampling method, data gathering process, and data analysis process. The data analysis, the results, and discussions of the findings are covered in the fourth chapter. The results, consequences, and suggestions are included in Chapter 5.

CHAPTER TWO

LITERATURE REVIEW

2.0 Overview

This study seeks to investigate the impact of peer teaching among teachers (in the area of subject matter knowledge and pedagogical skills) on students' academic performance in senior high schools. This aspect launches the conceptual framework on variables that have impact of peer teaching among teachers (in the area of subject matter knowledge and pedagogical skills) on students' academic performance in senior high schools, and the empirical studies on these variables in mathematics.

2.1 Theoretical Framework of the Study

2.1.1 Social Constructivist Learning Theories

According to Kukla and Walmsley (2006), the theoretical basis for learning through peer tutoring are provided by the social constructivist learning theories. The finest education necessitates student participation because, in the constructivist educational theory, fresh ideas are generated from prior knowledge of the learners. Constructivism asserts that students connect with peers who hold different opinions in order to develop new concepts (Prawat & Floden, 1994). Summers, as referenced by Austin, (2008), stated that students that practice peer tutoring use their skills and knowledge to help their classmates with their academics. As a result, peer tutoring is linked to the social constructivism theory. According to Powell and Kalina (2009), Social engagement and discussion among students in a collaborative learning setting help to promote learning according to social constructivism. In an environment of active learning, the tutor and tutee establish their social bond through good communication, which enhances peer interactions. Sometimes a student does not grasp the subject matter or the teacher's

explanation in class, but his partner or comrade can explain it to him in simple terms. It is not only information collection that is embedded or comprehended during conversation, but it is also fundamental cognitive processes. As a result, both pupils involved in communication profit.

Peer tutoring is linked to these social constructivist traits since it encourages students to work together socially (tutor and tutee). When peer tutoring is used, communication and discourse promote knowledge creation, which is advantageous to tutees. The tutee benefits by asking questions, coming up with new challenges, and giving feedback to the tutor. on the hand, the tutor gets advantage by addressing the challenges of the tutee; this is what is meant when someone says, "Who teaches, learns twice." Topping and Ehly (1998) developed a peer tutoring theoretical model that was based on cognitive development and socio-cultural theories. The primary reasons and causes, according to this model, were clear aims and plans for both the tutor and the tutee, maximum involvement with the activity, individual attention for the tutee, immediate feedback, enjoyment and stimulation in a unique learning scenario, and immediate feedback. Peer tutoring necessitates scaffolding and assistance from a tutor, as well as oversight of tasks within the zone of proximal growth.

Most students like the idea of getting help from their classmates while learning, according to Flores & Duran (2013). Peer tutors study or have studied the same academic subject as their colleagues they teach, thus they are aware of any difficulties that students might have. Other qualities that should be taken into account, include exchanging cultural and linguistic references, speaking more frankly, and having faith in one another. Over the years, there have been many different definitions of peer tutoring. Peer tutoring, according to Topping (2009), is when individuals from similar

social groups who are not certified teachers assist one another in their academic endeavors while also learning new skills. During this procedure, tutors are typically peers with greater talent or knowledge. As a result, there are both students who provide help and assistance to others (tutors) and students who receive it (tutees). It is necessary to operate in pairs when using this practise. With the same objective in mind (acquiring curricular knowledge), a professional therefore forms an unequal learning relationship with their students (Yang et al., 2016). For all the reasons listed above, it may be viewed as an approach that promotes collaborative learning and supports diversity in the classroom (Miravet, Garcia & Ciges 2013).

2.1.1.1 The Zone of Proximal Development

Peer-to-peer interaction is a catalyst for students' learning, as indicated by Woolfolk (2010), while Piaget and Vygotsky assert that social interaction plays a pivotal role in facilitating learning. Siyepu (2013) posits that Vygotsky's Zone of Proximal Development offers a theoretical foundation for peer tutoring. When children engage in problem-solving with the guidance of a more proficient peer, they acquire new skills. Vygotsky referred to this new frontier of intellectual growth as the Zone of Proximal Development (ZPD), which emerges when a child collaborates with a high-achieving mentor in an academically beneficial and dynamic context. The difference in a student's performance when aided by a tutor versus working independently is what constitutes the Zone of Proximal Development (ZPD). Piaget and Vygotsky emphasize the learning process over content, highlighting that students construct their own knowledge through active participation in diverse learning contexts. Instead of the stimulus-response model, the social constructivist perspective underscores students' role in generating learning (both as tutors and tutees) within their Zone of Proximal Development, actively

participating in the development of knowledge through cognitive accommodation or assimilation.

Peer tutoring, as shown by research from Ryan et al. (2004) and Flores and Duran (2013), has been proven to not only improve academic performance but also positively impact the psychological, behavioral, and attitudinal aspects of students. Therefore, it can be considered a highly advantageous educational approach for students. There are various forms of peer tutoring, which can be categorized based on two factors: the age of the students involved and their roles within the tutoring process. Alegre et al. (2019) identified two types of peer tutoring: cross-age and same-age tutoring. Meanwhile, Monliner Miravet (2020) identified two distinct types of peer tutoring based on the responsibilities of the students: fixed and reciprocal tutoring. Cross-age tutoring typically pairs students from different grade levels, and sometimes, different intellectual levels, whereas same-age tutoring usually involves students within the same grade level. Cross-age peer tutoring experiences, where older students assist younger ones, are quite prevalent, as noted by Kalkowski (1995).

While studies by Hartup (1976) and Scruggs and Osguthorpe (1986) suggest that tutees benefit most when older tutors assist them, the superiority of cross-age tutoring over same-age tutoring remains unproven. Topping et al. (2004) advocate for older tutors to ensure the success of the experience, recommending a two-year age gap between tutors and tutees. Vogelwiesche, Grob and Winkler (2006) report that participants in this type of interaction prefer cross-age tutoring. On the other hand, Rekrut (1994) and Sheldon (2011) found that the outcomes of same-age and cross-age tutoring were quite similar. Moreover, previous meta-analyses and literature reviews (Stenhoff & Lignugaris/Kraft, 2007; Topping, 1996) have not identified significant differences between them.

Additionally, proponents like Cohen (1986) and Ramani, Zippert and Daubert. (2016) argue that same-age tutoring is easier to implement organizationally than cross-age tutoring, primarily because same-age tutoring often occurs in the same classroom, avoiding the additional logistical challenges associated with cross-age tutoring.

Fixed tutoring is widely recognized as the most prevalent tutoring type in terms of participant roles (Miravet, Garcia & Ciges, 2013). In fixed tutoring, students retain their roles as tutors or tutees throughout the program without switching positions. Many educators and practitioners in the field find this type to be intuitive, as it allows more skilled students to educate their less skilled peers (Falchikov, 2003; Walker et al., 2009). Conversely, reciprocal peer tutoring involves students exchanging roles during the tutoring process (Pigott, Fantuzzo & Clement, 1986). Previous research in the field suggests that, from a psychological perspective, reciprocal tutoring is superior (Miravet, Garcia & Ciges 2013). The role exchange inherent in reciprocal tutoring appears to have the most significant impact on mathematics self-concept and attitude (Moliner & Alegre, 2020; Sutherland & Snyder, 2007). Notably, there have been no prior literature reviews or meta-analyses demonstrating significant variations in academic achievement between these two categories (Leung, 2015). Recent meta-analyses and literature reviews have extensively explored the academic achievement variable in peer tutoring for mathematics (Leung, 2015; Moeyaert, 2019; Zeneli, Thurston & Roseth., 2016).

These reviews and meta-analyses consistently report larger effect sizes in primary education than in secondary education. Alegre-Anzoategui et al. (2018) suggest that educational level may be a crucial moderator in such experiences, with greater effect sizes observed in primary education compared to secondary education. Cohen (1986)

proposes that peer tutoring's impact on academic achievement may vary significantly with age. Lodico et al. (2010) argue that instructional techniques should be compared under as similar conditions as possible (e.g., same type of students, same type of tutoring). While numerous studies have been included in these reviews and meta-analyses, each conducted under different conditions (various tutoring types, pair structures, tutor qualifications, and so on), no previous research has investigated the influence of peer tutoring in mathematics in primary and secondary schools under similar circumstances. Consequently, a comparison between elementary and secondary education is warranted, given the potential of this method in mathematics and the documented variations in effect sizes across different studies.

In this context, peer tutoring should be implemented in as similar a setting as possible at both educational levels. By minimizing organizational differences, academic achievement differences between the two levels can be more accurately examined, with the educational level being the primary variable of interest. This study focuses on mathematics due to its prior promising outcomes and its central role in the curriculum, as subjects like physics, chemistry, technology, biology, and science are all closely linked to mathematics. The primary objective of this study is to assess the impact of peer tutoring in mathematics in both primary and secondary school settings, allowing for a more realistic comparison by maintaining consistent organizational settings. Academic achievement in mathematics among students is evaluated using same-age and fixed peer tutoring approaches.

2.1.2. Cognitive Learning Theory

Teacher self-efficacy is theoretically predicated on Bandura’s (1986) social cognitive theory (Perera & John, 2020). From this standpoint, teacher self-efficacy refers to self-

referent judgments of the capability to organize and execute the actions required to successfully perform teaching tasks. This perspective subsumes both self-perceptions of personal teaching capability and judgments about the requirements of domain-specific teaching tasks, including appraisals of external constraints and resources, into the teacher self-efficacy content domain (Perera & John, 2020). The introduction of cognitivism which was identified as a theory in learning by some philosophers can be drawn back from the early twentieth century. This was seen a shift from the behaviourist theory by which it was identified by a number of restrictions or some form of limitations from which it's failed to examined why and how an individual could make sense and process information with the mind (how the work of the brain receives and process an information). In other words, cognitive theory was spawned through the limitations which came out of the behaviourism. There was a dissatisfaction with the behaviourism such that greater opinion was placed on the observable behaviours on the individual or the learner through stimulus and response rather that asserting that prior knowledge and mental knowledge which is the key definition of the cognitivist orient the individual learning process (Deubel, 2003). The cognitivist argue that people are not classified as a robots or animals that respond to environment stimuli. Among the pioneers of the cognitivist are from the work of Jean Piaget, Jerome Brunner, Edward Chase Tolman and Lev Vygotsky from whom they champion in engendering the change of the behaviourist theory to the cognitivist theory. The cognitive school explained learning through the learners as

1. Learning is an active process of obtaining knowledge by the organization of the cognitive structures from which the learner process and keeps an information with the mind.

2. The learner is identified as an active participant in the learning process where he/she receives and integrate information (Simon & Klandermans, 2001)

For this reason, the theory from the cognitivist stresses on the use of the learner's memory in where they see knowledge becomes meaningful and well arranged by the learner and well retained of the prior knowledge. Powell, Sobel, Hess & Verdi (2001) explained that instruction should be formalize on a student's existing structures or schema.

2.2 Conceptual Review

2.2.1 Mathematics as a Discipline

Mathematics is studied for various reasons. According to Paisey (2010), it serves as a gateway to understanding many other subjects and forms the basis for various sciences, including physics and astronomy, in a broader context (Lyons, 2008). In the realm of mathematics, children acquire crucial problem-solving skills that can be applied to various aspects of their lives. This discipline helps them think logically and approach things with a more sophisticated analytical perspective. Samuelson (2011) asserts that having a grasp of mathematics signifies that a student has acquired and mastered the mathematical skills necessary for solving specific problems, and these skills may take a considerable amount of time to develop (Avital, 2010). Effective teaching requires clear and instructive communication of this knowledge by educators (Soer, 2009). Moreover, the ability to make learning enjoyable and meaningful is paramount.

Mathematics offers a powerful, straightforward, and unambiguous means of communication that can be used to represent, explain, and predict events. Proficiency in mathematics is widely recognized and highly valued, as it fosters the development

of logical thinking, critical reasoning, as well as analytical and problem-solving abilities (Smith, 2004). In recent years, mathematical techniques have been rapidly integrated into the social, medical, and physical sciences, reaffirming mathematics as an indispensable component of all educational curricula and generating a strong demand for higher-level mathematical education at universities. The primary objective of mathematics education in schools is to cultivate mathematical thinking in students.

2.2.2 Peer Tutoring

In recent times, educators and scholars have increasingly focused their attention on peer tutoring. According to Topping (1996), peer tutoring is a teaching strategy with historical roots dating back to ancient Greek times. Peer tutoring involves a structured set of teaching practices where students interact with their peers within the same grade level during tutoring sessions (Rohrbeck, Ginsburg-Block, Fantuzzo & Miller, 2003). Peer tutors can range from experts to classmates who are the same age as them or low-achieving peers who are in the same age group, but it's important to keep in mind that there are several definitions of peer tutoring and they are not always consistent (Northwest Regional Educational Laboratory, 2001). Consequently, educators and researchers have developed various educational approaches grounded in the concept of peer interaction to enhance student performance in different academic areas and behavioral management. Instructional tactics for peer tutoring encompass class-wide peer tutoring (CWPT), reciprocal peer tutoring (RPT), peer-assisted learning strategies (PALS), and cross-age tutoring (Bolden, Zeneli, Tymms, & Bolden, 2018; Watts & Bryant, 2018).

As proposed by Boud and Cohen (2014), students acquire knowledge by articulating their ideas to others and engaging in situations where they can learn from their peers.

A unique aspect of peer tutoring is the reciprocal nature of the interaction, where one student assumes the role of the tutor while the other becomes the student, facilitating a two-way engagement aimed at assisting the tutee in acquiring skills or mastering content (Bettenhausen, 2002).

2.2.3 Benefits of Peer Tutoring

In our educational system, it's common practice to teach classes with varying levels of student abilities and needs, often in overcrowded settings. Consequently, having an effective teaching method to address such challenges is a fundamental requirement for educators. Peer tutoring, as outlined by Costantini (2015), has emerged as a valuable intervention for enhancing content knowledge and improving comprehension. Within the classroom, peer tutoring has proven beneficial in enhancing students' grades, expanding their understanding of subjects, increasing engagement, and fostering better classroom behavior. Peer tutoring is employed to support students in improving their skills in mathematics, reading, language, social studies, and English. As suggested by Bowman-Perrott (2009), it involves one-on-one coaching during implementation, allowing students to learn by teaching and correct their errors. This approach not only helps students achieve their academic goals but also enhances their social relationships. According to Bowman-Perrott et al. (2013), peer tutoring effectively promotes educational progress in elementary and secondary school courses, and students are incentivized through rewards.

For instance, in a seventh-grade math class, Kroeger & Kouche (2006) introduced PALS peer tutoring, where students with varying learning abilities assist each other in solving math problems regularly. PALS has proven to be a valuable supplement for students struggling with specific subjects. The reciprocal nature of tutoring, where each

student takes turns as a tutor and tutee, facilitates teaching and explanations for students who may be struggling, keeping them engaged in solving mathematical challenges. Kroeger and Kouche (2006) advocated for this intervention to help boost the confidence and engagement of weaker students in their studies. According to Spencer, Scruggs, and Mastropieri (2003), peer tutoring has led to increased academic achievements and improved classroom environments. Additionally, Horvath (2011) emphasizes that peer tutoring is a versatile and effective technique for addressing a wide range of educational concerns. It also allows students to work in one-on-one pairs in the classroom, fostering greater academic commitment. Kourea, Cartledge, and Musti-Rao (2007) and Topping (2005) provide further evidence that peer tutoring enhances students' academic performance. Moreover, it assists teachers in tailoring learning activities to meet the specific needs of all students and provides immediate support.

Mastropieri, Scruggs, and Graetz (2003) assert that peer tutoring strategies are successful and effective for high school students with learning difficulties. Similar to the findings of Miller, Topping, and Thurston (2010), Kourea Cartledge and Musti-Rao (2007) note that benefits for the tutee during peer tutoring include effective learning, personalized attention, the opportunity for free expression with a peer, and the development of camaraderie. Peer tutoring not only helps students achieve learning outcomes but also enhances their social and behavioral skills, such as communication, cooperation, and collaborative work within the classroom. It plays a crucial role in boosting learners' self-esteem. As emphasized by Topping (2005), peer tutoring is highly effective and beneficial not only for struggling students but also for gifted or high-achieving students. According to Topping, Miller, Thurston, McGavock, and Conlin (2011), students with low socioeconomic status, average students, and girls all benefited significantly from peer tutoring. Additionally, it encouraged previously

passive students to become more active participants in the classroom, promoting greater willingness to share their thoughts with peers, which they might hesitate to do with teachers (Maheady & Gard, 2010).

Another advantage of peer tutoring, as highlighted by Loke and Chow (2007), is the tutor's personalized assistance in the teaching process. Students who act as tutors experience increased self-satisfaction and self-confidence when helping their peers learn. Dvorak (2001) underscores that peer tutoring improves students' understanding, their attitude toward learning, their grasp of course material, their enthusiasm, and their career aspirations. It contributes to a positive learning atmosphere in the classroom. According to Scruggs, Mastropieri & Marshak (2012), peer tutoring enables teachers to assist students with varying abilities in mastering skills and acquiring knowledge, a level of individualized attention and pacing that traditional teaching methods may not provide. Okilwa and Shelby (2010) find that peer tutoring is effective for both students with and without learning challenges, particularly in English language acquisition. Goodlad (1999) notes that students in the tutee role actively engage with lessons, develop a liking for learning, and become genuinely interested in the subject matter. Additionally, peer tutoring helps students who take on the role of tutor enhance their communication skills, stay engaged in meaningful learning activities, and become familiar with their classmates' work in a specific subject. Both tutors and tutees experience increased self-confidence and improved understanding and proficiency in the subject matter, ultimately leading to a more enriched classroom experience for all students.

2.2.4 Peer Tutoring in Mathematics

Kiburis (2012) explored the implementation of Peer Tutoring, specifically within the Peer Assisted Learning Strategy (PALS) framework, in a 7th-grade regular education mathematics context. The study revealed that utilizing the PALS math program led to improvements in students' math performance when comparing their post-test scores to their pre-test results. PALS math proved to be a valuable resource for assisting students with a diverse range of learning skills, providing an opportunity for all students to practice and enhance their math abilities. In a similar vein, Hawkins, Masti-rao, Hughes, Berry, and McGuire (2009) implemented class-wide peer tutoring alongside randomized interdependent group-oriented contingency (IGOC) strategies within a general education math classroom, with the primary aim of enhancing multiplication fluency. This combined approach led to improved math performance among the students.

Calhoon and Fuchs (2003) delved into the effects of Peer Assisted Learning Strategies (PALS) in secondary-level mathematics, concluding that students participating in the PALS program exhibited strong performance and a deeper understanding of mathematical principles. According to Austin (2008), student-centered approaches have enhanced student achievement across subjects, including mathematics, at the elementary level, leading educational institutions to shift away from traditional teaching methods. The introduction of same-age and cross-age tutoring has demonstrated significant improvements in learning outcomes for students from diverse backgrounds. Topping et al. (2011) utilized cross-age peer tutoring and found that it contributed to increased math achievement and boosted self-confidence for both tutors and tutees. In addition, it enhanced motivation within mathematics classrooms, as highlighted by McMaster, Fuchs, and Fuchs (2006).

Austin (2008) also noted that peer tutoring in the classroom can effectively nurture problem-solving skills, a fundamental component of mathematical education and essential in daily life. Mastropieri et al. (2003) emphasized that peer tutoring is a well-organized and effective approach for curriculum enrichment and personalized attention, suitable not only for elementary but also middle and secondary levels. Ginsburg-Block, Rohrbeck, and Fantuzzo (2006) implemented PALS (Peer Assisted Learning), designed for academic purposes, and observed academic progress as well as enhancements in self-concept and social skills. Fuchs, Fuchs, Yazdin & Powell (2002) highlighted the substantial impact of peer tutoring on mathematics achievement, particularly for children with learning difficulties in mathematics. Dvorak (2001) advocated for peer tutoring as a cost-effective and beneficial tool, especially for students at risk or with lower academic performance in traditional lecture-based institutions.

Topping (2005) reported a significant increase in student academic achievement through the use of peer tutoring in the classroom. Spencer (2006) confirmed the effectiveness of peer tutoring as an educational strategy, particularly benefiting students with emotional and behavioural challenges. Walker (2007) applied peer tutoring in a high school mathematics class, with high-achieving students serving as tutors to assist peers struggling with arithmetic. This approach was found to benefit both tutors and tutees in mastering mathematical topics. Parsons, Croft, and Harrison (2009) reported that students who engaged in peer tutoring developed a positive self-concept, contentment, increased confidence, and higher levels of achievement. Mesler (2009) implemented peer tutoring in an urban high school with third-grade students, resulting in improved arithmetic skills for both tutors and tutees, ultimately achieving strong exam results.

Rheinheimer (2000) noted that students who received five hours of tutoring experienced improved academic performance. According to Dvorak (2001), peer tutoring increased students' chances of achieving academic goals, intellectual development, and admission to higher education. Peer tutoring, compared to traditional lectures, encourages students to ask more questions and raises their level of thinking as they teach their knowledge of a subject topic to a classmate. Greenwood (1997) found that in typical classroom situations, the peer relationship between students and teachers is limited, whereas peer tutoring has been proven to be effective in enhancing academic and social skills for all students, especially those facing academic challenges, across general and special education settings.

2.2.5 Peer tutoring: Learning to Teach and Teaching to Learn

As previously mentioned, interactions among students play a crucial role in the learning process. These interactions lead to cognitive conflicts that prompt students to learn from one another, as described by Vygotsky (1978). Some authors, like Duran (2004), argue that students can sometimes serve as better mediators than adults. They suggest that because students have recently mastered the material themselves, they are more attuned to areas where their peers might need additional assistance. Students often communicate more directly and can draw on shared cultural and linguistic references. Peer tutoring, as described by Topping (1996), refers to the collaboration of individuals from comparable social backgrounds who aren't professional educators, assisting each other in the learning process, with the added benefit of learning by teaching. The critical variables in different peer tutoring approaches encompass the participants' age groups and the duration of their involvement in these roles.

Two primary categories of peer tutoring are cross-age tutoring and same-age tutoring. In North American contexts, cross-age tutoring is more prevalent. According to Linton (1973), tutees who are tutored by peers four years their senior tend to show more improvement. Lippit (1976) suggests that a two- to four-year age difference is optimal for the effectiveness of the tutoring process, with the best results typically seen between a two- to four-year age gap. Although Allen and Feldman (1976) discovered that students typically preferred this arrangement, recent research suggests that the most effective tutoring often takes place between peers of similar ages, commonly known as same-age tutoring. Burnish (2005) and Topping (2008) both propose that same-age tutoring can be equally, if not more, successful than tutoring between individuals of varying ages. Additionally, same-age tutoring provides the extra benefit of cultivating stronger connections among students, and since it happens within the same class group, it doesn't necessitate extensive advance preparation. (Duran, 2003).

Leung (2015) conducted a meta-analysis to assess the effectiveness of cross-age and same-age peer tutoring and found that both were equally effective. Same-age tutoring can take two forms depending on the roles of the students: fixed or reciprocal tutoring. In fixed peer tutoring, both the tutor and tutee always have the same role, with one explaining while the other asks questions. In reciprocal tutoring, however, the roles are reversed.

2.2.6 State of the Art: The Potential of Peer Tutoring

Nearly every meta-analysis in the literature underscores the significant potential and positive impact of peer tutoring on students' academic achievement and emotional well-being. For instance, Ritter, Denny and Albin (2006) examined the effectiveness of 21

volunteer peer tutoring programs and found that these interactions led to improved academic performance among students. Furthermore, peer tutoring had a favorable influence on emotional factors in addition to academic outcomes. In a comprehensive review of 38 studies, Spencer (2006) observed that peer tutoring had a beneficial effect on adolescents' emotional and behavioral aspects, whether they served as tutors or tutees. Byrd (1990) conducted a review of 18 empirical studies and concluded that peer tutoring had positive effects on various aspects, including students' social integration, self-esteem, academic performance, and classroom atmosphere.

Secondary school studies have also demonstrated the benefits of peer tutoring for students. Flores and Duran (2013) investigated how tutoring enhanced students' reading self-concept, while Gavota et al. (2010) explored how review and correction peer improved their writing skills. Scheeler et al. (2010) found that the prompt feedback from tutors enhanced the oral expression of their peers. Spörer, Brunstein, and Kieschke (2009) reported that peer tutoring improved students' reading comprehension skills, and Duran and Monereo (2008) found that both fixed and reciprocal peer tutoring enhanced students' self-concept. In subjects like physics, structured peer tutoring programs, as noted by Ismail and Alexander (2005), produced superior results. Additionally, Gautreaux (2005) and Nazzal (2002) revealed that peer tutoring contributed to improved academic performance in mathematics. These advantages align with the educational, social, and emotional outcomes that most educators aspire to achieve in their classrooms. This study primarily emphasizes the academic benefits of peer-to-peer learning across various fields of study. The literature review identified three key constructs that form the foundation of this research, each with its unique features.

2.2.7 Academic Performance

To assess the effectiveness of a learning-teaching approach in improving performance and the acquisition and consolidation of knowledge and skills, it is essential to provide evidence. Academic performance serves as a metric to evaluate students' ability to express what they have learned during their educational journey. It involves assessing the knowledge acquired within the educational context. Knowles (1977) defines academic performance as "the demonstrated achievement of learning as opposed to the potential for learning," where achievement is measured by knowledge acquired or skills developed in school subjects, typically assessed through test scores or teacher-assigned grades. Numerous studies have explored the mathematical performance of secondary school students. Martin and Debus (1998) discovered that both motivation and mathematics self-concept played pivotal roles in students' mathematics performance. This finding aligns with Pajares' (2008) theory, which suggests that students who perceive themselves as more competent in a particular subject or field of study are more likely to engage in tasks related to that domain and achieve higher grades. In a study involving 341 seventh-grade students, Miñano and Castejón (2011) observed that self-concept varied based on students' classroom experiences. The motivational profiles and academic achievements of students are more influenced by their experiences of success or failure in specific areas than by their innate aptitudes, emphasizing the interdependent relationship between motivation and learning/performance. In essence, motivation impacts the processes of learning and performance, and what students learn and accomplish also affects their motivation. This theory has been proposed by authors such as Pintrich, Marx, and Boyle (1993).

2.2.8 Mathematics Self-Concept

Although various authors have explored the concept of self-concept, there is no universally agreed-upon definition. Hattie (2014) defines self-concept as "the cognitive assessment an individual makes of their beliefs, descriptions, and prescriptions about themselves." Shavelson and Bolus (1982) describe self-concept as "an individual's perception of themselves," and note that these perceptions are shaped through interactions with and interpretations of their surroundings. They are particularly influenced by judgments and feedback from significant others, as well as individuals' attributions for their own behavior.

In the context of this research, which focuses on the field of mathematics, it's pertinent to discuss the concept of mathematics self-concept. According to Gómez-Chacón (2000), a student's mathematics self-concept is one of the factors that will have the most significant impact on their learning. Many authors emphasize the importance of mathematics self-concept in mathematics education, as it is closely linked to students' attitudes, perspectives, and social identities (Young-Loveridge, 2010). Mathematics self-concept encompasses elements such as interest in mathematics, proficiency in mathematics, motivation, enjoyment of mathematics, and the attribution of success or failure in mathematics to chance. As described by Gomez-Chacón (2000), mathematics self-concept relates to how individuals perceive and value themselves in the context of learning mathematics. It is intrinsically connected to each person's perceptions about the world of mathematics, which evolve throughout their educational journey.

2.2.9 Attitude of Solidarity

The Spanish education system outlines a set of fundamental principles for each compulsory school subject, emphasizing their importance in the classroom. Among

these principles, the notion of solidarity is prominently featured in the LOE (Organic Law of Education) on seven occasions. Consequently, the concept of solidarity is deeply ingrained in the contemporary educational system's objectives and aims. According to Hondrich and Koch-Arzberger (1992), solidarity can be defined as a sense of community among individuals who, despite their differences, believe they share common goals. It entails a voluntary commitment to support one another when one has achieved more and the right to receive support if circumstances change. Beyond legal mandates, most authors concur that students should be educated not only from an academic perspective but also from a moral standpoint. Moral education and the cultivation of attitudes, as suggested by Cortina (1998), are fundamental activities even more crucial than the mere transmission of information. Prosocial behaviours are actions that benefit others in some manner. The direction of one's behaviour is influenced by their attitude, which is an evaluative judgment about objects, individuals, or facts (Robbins, 1991). Prosocial behaviours encompass behaviours that contribute to the well-being of others, groups, or societal objectives. It also fosters the likelihood of fostering positive and high-quality reciprocity rooted in solidarity within interpersonal or social relationships. Furthermore, it safeguards the identity, creativity, and initiative of those involved (Roche, 1998). Recognizing the uniqueness of others leads to the emergence of a genuine 'we' without boundaries, and this universality serves as an ideal environment for education to flourish. The distinctive space of solidarity (Escámez, 1999) represents the dynamic relationship between individual recognition and the opening up to the broader world. Peer tutoring is a collaborative learning technique with numerous potential benefits for students. This study aims to examine the impact of peer tutoring on teachers' emotional well-being (self-concept), their attitudes (solidarity), and students' academic performance. Through participant observation and feedback, we

intend to gauge teachers' level of satisfaction with the peer tutoring program, as well as the relationships and support they experience within it.

2.2.10 Teacher Quality

Teacher quality is a complex and multifaceted concept that encompasses a wide range of skills, attributes, practices, and outcomes, all of which have been extensively explored in the literature (Goe, 2007). However, despite the emphasis on teacher quality, there is often disagreement among educators and policymakers regarding its definition, evaluation, and utilization (Knight, 2012).

Teacher quality serves different purposes for policymakers and school administrators. Policymakers use it as a yardstick to evaluate whether individuals meet specific quality standards or not, as observed by Thien et al., (2015). Conversely, school administrators see teacher quality as a tool to identify the most suitable teacher for a specific role based on a defined set of characteristics and abilities. Within the school system, teachers in various roles may interpret teacher quality in diverse ways. For classroom teachers, teacher quality often signifies an ongoing process of self-improvement and professional development aimed at enhancing the quality of their own teaching. On the other hand, teacher educators tend to perceive a quality teacher as someone possessing strong subject knowledge and instructional methods that can be continually developed and strengthened throughout their career.

Defining and measuring teacher quality is a complex task, and there is no unanimous agreement on a single definition of teacher quality, as noted by Goe, (2007) and Moyer-Packenham et al., (2008). Research has also uncovered the challenges associated with evaluating the connection between teacher quality and student achievement.

Nevertheless, studies conducted in various countries have consistently demonstrated that teacher quality indicators, including teacher certification, subject matter expertise, educational background, experience, beliefs, behaviors, and practices, are correlated with students' math achievement outcomes (Bolyard & Moyer-Packenham, 2008; Clotfelter, Vigdor, & Ladd, 2006; Darling-Hammond, 2000; Darling-Hammond & Youngs, 2002). The National Council of Teachers of Mathematics (NCTM) Board of Directors (2005) outlined teacher quality as comprising attributes such as appropriate mathematical content knowledge, a deep interest in mathematics, a commitment to lifelong professional improvement, the desire and skill to facilitate students' learning and application of mathematical knowledge, and the ability to utilize the necessary resources for effective teaching. Professional development for teachers is widely recognized as a crucial approach to enhancing teacher quality, particularly in terms of pedagogical content knowledge and practices (Dash et al., 2012). Training serves as a tool for bringing about significant changes in teachers, redefining their roles, expanding their vision, and improving their teaching attributes. Teacher training programs conducted while teachers are already in service assist educators in developing more organized and rational teaching approaches. (Hervie & Winful, 2019).

Research findings indicate that students instructed by teachers who have engaged in professional development programs focusing on higher-order thinking skills tend to achieve better results in mathematics assessments than their counterparts (Wenglinsky, 2000). Additionally, literature provides evidence suggesting that teachers who have received professional development training can enhance their students' academic performance by approximately 21 percentile points (Yoon, Duncan, Lee, Scarloss, & Shapley, 2007). For instance, a study by Hervie and Winful, (2019) found that the lack of frequent in-service training, among other factors, contributed to poor teacher

performance in Ghana. Therefore, it can be concluded that professional development training does improve teacher quality to some extent. However, one of the challenges teachers often face is that traditional professional development programs do not always address their specific needs (Kleiman, 2004).

2.3 Emprical Review

2.3.1 Peer Tutoring and Mathematics Achievement

Peer collaboration and cooperation among teachers are recognized as pivotal elements for enhancing teachers' professional development. Renowned international researchers like Ni Shuilleabhain and Seery (2018) and Hargreaves and Fullan (1992) contend that for meaningful and effective transformation to take place in the classroom, it is imperative to foster a culture of collaboration among teachers. Such collaboration forms a crucial part of teachers' ongoing learning journeys within their communities and is instrumental in addressing content gaps that may arise in certain subjects or topics. When teachers collaborate within a community, it creates a robust framework where individual educators can explore and reflect upon novel teaching and learning methodologies aligned with their specific school context, students, and culture (Dogan, Pringle & Mesa, 2016; Vescio, Ross & Adams, 2008). The ultimate goal is to determine what instructional approaches work best for students, a vision shared by both teachers and educational authorities.

While the concept of teamwork is prevalent in environments like the United States Army, it has been observed to have limited implementation within the academic realm (Charbonneau et al., 2010). An international review of related literature highlights that effective collaboration among peer teachers for lesson planning contributes significantly to the development of teachers' pedagogical knowledge. Furthermore,

collaborative efforts foster a learner-centered approach to mathematics education (Dudley, 2013; Lewis, Perry & Hurd, 2009). Engaging in collaborative endeavors with peers, where the aim is mutual support, enables teachers to engage directly with the curriculum. This process involves delineating the objectives and goals of their teaching and crafting lessons that are intricately aligned with both the philosophical underpinnings and the content of the curriculum (Cajkler, Wood, Norton & Pedder 2014; Takahashi & McDougal, 2016). This collaborative ethos, akin to leaders empowering their subordinates to accomplish specific missions, resonates with teachers' interactions with students on a daily basis.

Peer collaborative work in lesson planning and design necessitates reflection on action, which empowers teachers to comprehend mathematical concepts—whether they are challenging or straightforward. This approach also encourages critical thinking among students and fosters experiential learning (Myers, 2012). The capacity to continuously and thoughtfully evaluate what and how teachers teach, along with reflecting on their roles as educators to discern what best serves their students, is fundamental to effective teaching. In cases where certain mathematical concepts pose difficulties for teachers and students alike, collaboration and cooperation among teachers become indispensable in gaining a deeper understanding of these concepts and devising innovative instructional strategies.

Peer tutoring has always played a pivotal role in education, dating back to the era of one-room schoolhouses when older students were enlisted to assist their younger counterparts. Over time, it has evolved into a versatile tool for educators, serving as a means to aid struggling students, both in face-to-face and online settings. The fundamental elements of peer tutoring have remained consistent. It provides students from diverse backgrounds with accessible, cost-free support, offering educators a wider

range of strategies to assist their students and fostering positive relationships among peers.

Personalised instruction, practise, reinforcement, and concept clarification are all provided by peers acting as one-on-one teachers in the practise known as peer tutoring (Bowman-Perrot et al., 2013). Peer tutoring was initially designed on the premise that only "top-performing students" could act as tutors. The current vogue is to evaluate each student's aptitude in a particular subject. Researchers are exploring the benefits of pairing students with similar cognitive abilities when implementing tutoring programs. This approach may foster stronger connections between peers, thereby increasing participation in the tutoring process.

Peer learning goes beyond just putting two students together and hoping for the best, where both students involved gain from the experience. Peer learning should be introduced into classrooms or schools after taking into account a variety of aspects. Peer tutoring should be included in teacher preparation programmes and in-service training for working educators (Bowman-Perrot et al., 2013, p. 39). Effective teacher training plays a critical role in the success of any peer tutoring initiative. Once educators are trained, they must consider various variables, such as timing, grade level, aptitude, location, voluntary or mandatory participation, and curriculum, among others. The program must yield advantages for both the tutor and the tutee, while also avoiding any social divisions based on perceived ability and status, as this promotes continued involvement (Topping, 2005, p. 634). Research has consistently shown the positive impact of peer tutoring in various educational contexts. For instance, Okilwa and Shelby (2010) discovered that peer tutoring led to improved academic outcomes for students, regardless of their disability types. Calhoon and Fuchs (2003) examined the

impact of Peer Assisted Learning Strategies (PALS) in secondary mathematics instruction and came to the conclusion that PALS programme participants demonstrated good performance and a deeper comprehension of mathematical concepts.

Furthermore, Topping et al. (2011) employed cross-age peer tutoring to explore factors contributing to enhanced mathematical achievement. The study found that peer tutoring resulted in increased math proficiency and boosted self-confidence in both tutors and tutees. Additionally, motivation in mathematics classes experienced an upswing according to McMaster, Fuchs and Fuchs (2006), while Fuchs et al. (2002) highlighted the substantial positive impact of peer tutoring on mathematics achievement.

Peer tutoring and cooperative learning practices have also shown promise for students with learning difficulties in mathematics, leading to improved math scores. Rheinheimer (2000) reported significant improvements in student grades after receiving five hours of tutoring. Peer tutoring improved students' chances of accomplishing academic objectives, intellectual growth, and admittance to higher education, according to Dvorak (2001). In contrast to traditional lectures, peer tutoring encourages students to ask more questions and elevates their cognitive engagement by allowing them to convey their knowledge of a subject to a fellow classmate.

In essence, peer tutoring is a well-documented and effective educational strategy with numerous benefits for both tutors and tutees, contributing to improved academic outcomes and fostering a more interactive and engaged learning environment.

2.3.2 Teacher Efficacy and Mathematics Achievement

Teachers' sense of efficacy has a profound and positive impact on various aspects of their professional lives and the outcomes of educational projects. Specifically, it not only enhances student performance but also plays a pivotal role in achieving project goals, driving teacher adaptation and change, and promoting the continued utilization of project methods and materials even after project completion. This robust relationship between teacher self-efficacy and project success underscores the significance of educators' belief in their own capabilities. Looking beyond project-specific contexts, teacher self-efficacy is widely recognized as interconnected with several other factors that influence the teaching profession. For instance, research by Moè, Pazzaglia and Ronconi (2010) suggests a positive correlation between teacher self-efficacy and job satisfaction, highlighting the role of self-belief in teachers' overall career contentment. Additionally, studies by Comerchero (2008) indicate a link between teacher self-efficacy and perfectionism, shedding light on how educators' confidence in their abilities relates to their pursuit of excellence.

Moreover, teacher self-efficacy has been associated with emotional intelligence, as demonstrated in the works of Moafian and Ghanizadeh (2009) and Rastegar and Memarpour (2009). These studies illustrate the intricate interplay between educators' emotional competencies and their perceived self-efficacy, emphasizing the multifaceted nature of effective teaching.

Conversely, teacher self-efficacy has shown a negative relationship with teacher burnout, as evidenced in research by Brouwers and Tomic. (2000) and Comerchero (2008). This implies that higher levels of self-efficacy may act as a protective factor against the emotional and psychological exhaustion often experienced by educators.

Tschannen-Moran, et al. (1998) assert that teacher self-efficacy is of paramount importance, as it is closely associated with effective teaching. They posit that effective teachers tend to possess a strong sense of self-efficacy, which contributes significantly to their pedagogical growth and development. This assertion underscores the critical role that self-belief plays in shaping teaching effectiveness. The complex relationship between self-efficacy, reward, and performance is also explored in recent research by Tzur, Ganzach and Pazy (2016). Their findings imply that the level of reward involved determines how self-efficacy affects performance. In particular, self-efficacy has a favourable impact on performance when the stakes are high, while having a negative impact when the stakes are low. This demonstrates how self-efficacy is contextual and how it affects task performance.

Mustafa, Glavee-Geo, Gronhaug and Almazrouei (2019) investigate how structural elements like formalisation and centralization influence employee self-efficacy and its consequent impact on task performance in a more organisational setting. Their research shows that centralization has a negative correlation with self-efficacy whereas formalisation has a favourable correlation. These increases or decreases in self-efficacy are partially translated into better performance. It's interesting to note that high levels of formalisation and centralization weaken the link between performance and self-efficacy. This study emphasises how organisational structure affects people's perceptions of their talents and, in turn, how well they perform at work.

In summary, teacher self-efficacy is a multifaceted construct that significantly influences various aspects of teaching and organizational performance. It impacts student outcomes, project success, job satisfaction, emotional intelligence, and even the relationship between self-efficacy, reward, and performance. Understanding and

fostering teacher self-efficacy is essential for improving educational practices and outcomes.

2.3.3 Teacher Quality on Mathematics Achievement

Teaching experience, particularly extended periods of it, holds a significant and positive association with student success in Taiwan, aligning with the findings of Monk (2007). This underscores the idea that teachers' years of experience with students contribute positively to educational outcomes. However, in a different context, no such correlation between these variables was observed, which is consistent with the findings of Zuzovsky and Donitsa-Schmidt (2017). In this context, it suggests that the impact of teacher experience on student success in mathematics and science may vary and exhibit statistically inconsistent effects. Another crucial determinant of teacher quality is pedagogical readiness, a factor that consistently influences student achievement, as demonstrated by Metzler and Woessmann (2010). Pedagogical readiness encompasses certain teacher behaviors that foster students' needs for autonomy, competence, and relatedness, as defined by Arends et al. (2016). These behaviors are essential in promoting students' sense of self-determination, efficiency, confidence, and connection, ultimately contributing to their academic success. In summary, the relationship between teacher experience and student success can vary depending on the context, as seen in the differing findings in Taiwan and the other context mentioned. Nevertheless, pedagogical readiness, characterized by specific teacher behaviors that fulfill students' psychological needs, consistently emerges as a critical factor in enhancing student achievement. According to Njeru and Orodho (2003), it is argued that teachers' experiences and educational qualifications significantly influence students' academic performance. In the context of education, feedback is defined as

guidance provided by teachers to students to bridge the gap between their current performance and the desired learning outcomes (Benegusenga, Kimpolo, Okech & Ondiaka, 2017). Students require feedback from assessments as a fundamental aspect of their pursuit of quality education. Presently, it is widely recognized that feedback from teachers plays a pivotal role in students' improvement or potential setbacks. Additionally, teachers are often better equipped to identify students' weaknesses during their teaching and learning activities (Mamoon-Al-Bashir, 2016). Within classroom settings, teachers can offer various forms of feedback, including general feedback for the entire class to address issues such as time management and personalized feedback tailored to individual students.

Feedback systems are instrumental in achieving learning objectives and provide learners with autonomy in their educational journeys beyond standardized curricula. Teacher feedback holds a crucial role in helping students reflect on their capabilities and motivating them to address areas where they may be lacking (Mamoon-Al-Bashir, 2016). This type of feedback is an essential component of ongoing assessment during the teaching process. It serves to inform teachers whether their teaching aligns with classroom learning objectives. Effective utilization of feedback is pivotal, as it equips students with insights into their past performance and guides them on how to approach future activities.

In addition to feedback, effective communication and collaboration are recognized as vital qualities in teachers. As per Khan, Zia-ul-Islam, Khan, and Education (2017), communication skills involve transmitting messages with shared understanding within the context of the communication. These skills encompass listening, speaking, reading, and writing. Research conducted by Ehindero and Ajibade (2000) highlights that for effective teaching to occur, teachers must possess good communication skills, adept

classroom management abilities, updated subject knowledge, and a positive personality. Effective communication skills enable teachers to simplify complex concepts and enhance comprehension among students. These skills are critical for successful knowledge transmission, classroom management, and interaction with students.

To tailor instruction to students' abilities and potential, teachers must employ communication skills that inspire and motivate students in their learning journey (Semir, 2018). Consequently, proficient communication skills are fundamental to students' academic success and their future professional accomplishments. Inadequate communication skills among teachers can hinder students' learning progress and impede their educational advancement. It is essential for students to grasp the difference between right and wrong, and this reliance on the teacher's communication skills is paramount within the classroom (Sherwyn, Michael, Osborn & Pearson, 2000). Effective communication minimizes the likelihood of misunderstandings during the teaching process. For effective learning, students must be attentive to their teacher's instructions during lectures. Communication is an active process that requires focus and the courage to engage with others and convey messages effectively.

2.3.4 Teacher Efficacy and Mathematics

Research has indicated that teachers' belief in their efficacy significantly impacts students' learning and academic achievement. Teachers who possess high levels of self-efficacy tend to prioritize their teaching activities over non-academic tasks (Gibson & Dembo, 1984) and have a positive influence on student achievement (Armor et al., 1976). They also tend to experience greater job satisfaction (Klassen & Chiu, 2010).

Additionally, the level of teachers' efficacy is closely linked to students' attitudes toward school. The beliefs teachers hold about their own efficacy influence the decisions they make in their classroom practices, which, in turn, affect students' academic performance (Kagan, 1992; Nussbaum, 1992; Hunt, 1976; Rowan, Chiang, & Miller, 1997; Brophy, 1986).

It's worth noting that there is limited research on the efficacy of elementary mathematics and science teachers. However, the following literature review at the elementary level provides a general understanding of existing research findings up to this point. Teachers' teaching efficacy beliefs are primarily developed during their early student teaching experiences (Hoy & Spero, 2005). Scholars have examined teacher self-efficacy in pre-service teachers and strategies to enhance their efficacy beliefs. Nonetheless, there has been limited research on increasing the efficacy beliefs of in-service teachers (Swackhamer, Koellner, Basile, & Kimbrough, 2009).

Furthermore, once efficacy beliefs are established, they tend to be resistant to change (Bandura, Freeman, & Lightsey, 1999), which underscores the importance of studying the sense of efficacy in elementary pre-service teachers (Hoy & Spero, 2005). Moreover, self-efficacy plays a significant role in novice teachers' learning stages, which has limited the exploration of self-efficacy in practicing or in-service teachers. However, reports indicate that pre-service teachers' general teaching efficacy increases, although it declines during the student teaching experience due to underestimation of the complexities of teaching (Hoy & Spero, 2005). Research on self-efficacy beliefs supports the idea that teacher self-efficacy tends to increase during the student teacher period but decrease during the first year of teaching. This is attributed to the lack of support that in-service teachers receive compared to pre-service teachers (Hoy & Spero, 2005).

Elementary teachers are responsible for teaching various subjects. As efficacy beliefs are domain-specific constructs (Bandura, 1981), teachers may experience varying levels of efficacy across the subjects they teach. However, in general, when comparing the efficacy beliefs of elementary teachers to those of middle and high school teachers, elementary teachers tend to report higher efficacy beliefs. A study by Wolters and Daugherty (2007) examined the variation in teachers' self-efficacy levels based on the academic level they teach. It was found that teachers who teach higher grades tend to report lower self-efficacy, while elementary school teachers report higher levels of self-efficacy for student engagement compared to teachers in middle or high schools.

In a study by Lee, Cawthon and Dawson (2013), which was part of a larger research effort, teachers' sense of efficacy was compared between elementary and secondary teachers. The findings revealed that elementary teachers tend to have significantly higher levels of efficacy than their secondary counterparts. Pre-service teachers often report that teaching upper grades, especially in subjects like mathematics, is more demanding than teaching lower grades (Charalambous, Philippou & Kyriakides, 2008). Several studies have also pointed out that elementary teachers may feel less comfortable teaching mathematics and science (Buss, 2010). Specifically, teaching science at the elementary level is an area where teachers may feel less confident (Howitt, 2007). Buss (2010) conducted a survey involving 325 pre-service teachers who completed the necessary coursework and student teaching to become certified to teach all elementary subjects, including mathematics and science. The findings indicated that teachers' efficacy for teaching reading, classroom management, and general instruction tends to be higher than their efficacy for teaching mathematics and science.

Wenner (2001) conducted research comparing efficacy beliefs between in-service teachers and pre-service teachers, measuring the efficacy beliefs of elementary

mathematics and science teachers in both groups. A total of 101 in-service teachers and 187 pre-service teachers completed the Science Teaching Efficacy Belief Instrument. Wenner (2001) concluded that teachers' experiences significantly influence their perceptions of their ability to teach. Consequently, in this study, in-service teachers reported higher levels of efficacy compared to pre-service teachers. Both groups held similar beliefs regarding their responsibilities for student achievement and their impact on student motivation.

Wenner (2001) also highlighted that science education remains an area of low confidence, particularly among pre-service teachers. Finally, the study noted that both in-service and pre-service teachers reported higher efficacy for teaching mathematics compared to teaching science. Pas, Bradshaw, and Hershfeldt (2012) conducted a longitudinal study aimed at identifying factors influencing changes in teachers' efficacy over time. A total of 600 elementary teachers completed the Teacher Sense of Efficacy scale developed by Hoy and Woolfolk (1993). Data was collected at three different points over two academic years, and the study concluded that teachers' efficacy tends to increase over time. Factors such as gender and race were found to be unrelated to changes in teachers' efficacy. However, preparedness was identified as a significant factor influencing changes in teachers' efficacy over time.

This comprehensive literature review offers insights into the development and variation of teacher efficacy beliefs, particularly among elementary teachers, and underscores the importance of understanding these beliefs within the context of subject areas taught.

2.4 Conceptual Framework

According to Sitko's (2013) definition of conceptual framework, it is a set of ideas, presumptions, expectations, beliefs, and theories that support and provide guidance for the study. In this study, it is hypothetical that, there is an effect of Peer Tutoring (PEER_TUT) on Teacher Efficacy (TE_EFF), Teacher Quality (TE_QUA) Student Mathematics Achievement (SMA). The conceptual framework for this current study is presented in a diagram as shown below.

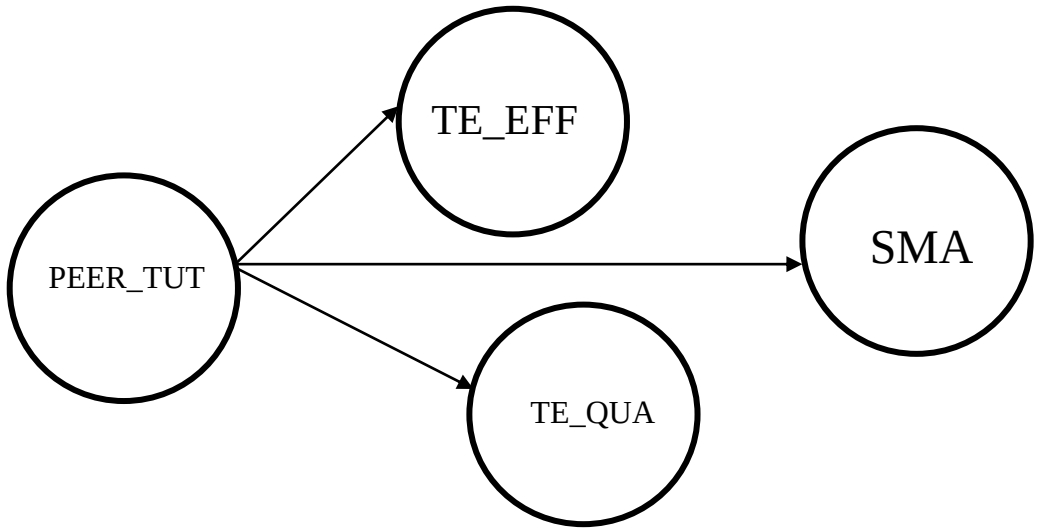

Figure 1: Conceptual Framework showing Relationship among the variables

2.4 Conclusion of the Chapter

This chapter is accounted for the conceptual background, theoretical framework and empirical framework that concerns this current study.

CHAPTER THREE

METHODOLOGY

3.0 Overview

This chapter outlines the methodology utilized for this study, specifically emphasizing the research design, target population, sample selection and methodology, research tools, validation and consistency, process of data collection, analysis approach, and ethical protocols.

3.1 Study Area

The study took place in Ghana's Ashanti region. The Ashanti area is located in central Ghana, roughly between latitudes 5.500 N and 7.460 S and longitudes 0.15 E and 2.250 W. It occupies 24,389 km2 of total land area, or 10.2% of Ghana's total land area. In addition to Bono East, Western Region, Eastern Region, and Central Region, it is bordered by these regions as well. Of the sixteen (16) administrative regions, it is the third largest. The Ejisu Municipality served as the precise location for the study. The municipality is renowned globally for its flourishing kente weaving industry and its abundant cultural heritage. It encompasses a total area of 637.2 square kilometers. According to the 2021 population and housing census, there is a population of 92,887 females and 87,836 males residing in the municipality. The study was carried out at Church of Christ Senior High School and Achinakrom Senior High School, two of the five senior high schools in the municipality. The study area is depicted in the figure below.

Figure 2: Study Area

3.2 Research Paradigm

Thomas Kuhn, a philosopher from the United States, used the term "paradigm" to describe a philosophical outlook. According to Mackenzie and Knipe (2006), the word paradigm in educational study means the “worldview” of the researcher. Kivunja, Ahmed, & Kuyini. (2017) explain “worldview” as the mindset or standpoint, or viewpoint that infuse the conotation or explanation of the data of a study. This means that research paradigm informs the philosphical orientation of the study and also informs the choosing of a methodology by a reseacher. The paradigm of this research is pragmatic paradigm because it adopts mixed methods in the gatering and analysis of data. This paradigm was born out of the argument that “truth” can not be obtained through the use of only one scientific method (Kivunja et al., 2017). Some philosophers

(Alise & Teddlie, 2010; Biesta, 2010; Patton, 1990) argued that the most appropriate worldview is one that makes available research methods that can best be used in the investigation of the research problem at hand. Therefore these philosophers searched for viewpoints which permits the use of different methods that can throw more light on the research problem (Kivunja et al., 2017). This led to the development of mixed approaches as a practical approach to comprehending human behaviour.

3.3 Research Design

In the attempt to gather and analyse data, a mixed methods research design specifically sequential exploratory method was adopted in the study. This is based on a knowledge that provides a general understanding of the research problem using qualitative data and its subsequent analysis (Creswell & Plano Clark, 2005). Quantitative data and analysis refine and illustrate statistic findings (Creswell, 2013). The study is based on the presumption that qualitative and quantitative research methods can be combined to achieve different perspectives on the paradigms. To better grasp the research problem, Creswell (2013) claimed, qualitative and quantitative methodologies should be used. He asserted that pragmatism allows for the use of several methodologies, various assumptions, and various types of data gathering and analysis in a mixed-methods study. The researcher believes, therefore, that pragmatism is the ideal philosophical view for the study. In mixed methods, it is essential to understand how qualitative and quantitative research methods operate. The basic principle of mixed research approaches should be fully known by researchers using the mixed research methodology (Johnson & Turner, 2007). This approach acknowledges that all research methodologies have both benefits and weaknesses. Johnson and Turner (2007) argue in this regard that if this approach is used in the gathering of data,

consequently, multiple data collection techniques should be used such that the researchers' combination may provide convergent and divergent evidence of the physical event". The mixed methods research's ultimate objective is to use quantitative and qualitative methods to minimize the weaknesses in a single study (Johnson & Onwuegbuzie, 2004). The notion that quantitative data can also help to explain the findings from the qualitative investigation forms the basis for the justification for utilising a sequential exploratory strategy. According to Kuranchie (2021), qualitative approach requires the researcher to actively involved in the study which enable him understand the subjective meanings constructed by the participants.

Quasi-experimental research design was also used for the study's quantitative portion. The investigation of causal relationships between independent and dependent variables is carried out through the utilization of experimental and quasi-experimental research methods (Rogers & Révész, 2020). According to Loewen and Plonsky (2016), the independent variable is the factor that produces an influence, whereas the dependent variable is the factor that undergoes an impact. In simpler terms, it was expected that the independent variable would lead to changes or modifications in the dependent variable. The rationale for using quasi-experimental research design was to enable the researcher manipulate a variable (peer teaching among teachers) and observe the effect of the manipulation on the other variables (students' achievement) (Kuranchie, 2021).

3.4 Population

All senior high school students in the Ejisu municipality and senior high school teachers made up the study's population. The schools in the Ejisu Municipality namely, Achinakrom Senior High School, Onwe Senior High School, Ejisu Senior High and

Technical School, Ejisuman Senior High School and Church of Christ Senior High School. were chosen for this study because of the researcher's convenience and accessibility to the students and the mathematics teachers that were involved in the study. Achinakrom Senior High School has a total population of 1,604 students and 137 teachers including the researcher. Onwe Senior High School also has a population of 365 students and 55 teachers. Ejisuman Senior High School has a student population of 3,956 and a teacher population of 158. Ejisu Senior High Technical School has a student population of 3,630 and a teacher population of 175. Church of Christ Senior High School has a student population of 1007 and a teacher population of 56 Therefore, the total population of the study is 10,562 students and 581 teachers. The students of the schools have almost the same entry behavior in terms of their academic performance in mathematics. Students of the schools offer Mathematics as a core subject which is a requirement for their further studies.

3.5 Sample and Sampling Technique

The researcher used a non-probability sampling technique in the sample selection. In this technique, samples are selected purposively and not every member of the population has the opportunity of being chosen to be part of the study (Kuranchie, 2021). Purposive sampling was the kind of non-probability sampling approach used. Purposive sampling technique is one in which the researcher intentionally selects subjects to be part of a study on the grounds that they possess a particular feature required (Cohen, Manion, & Morrison, 2007). According to (Kuranchie, 2021), sample size selected through non-probability sampling technique is not determined by statistical means or calculations. The researcher therefore selected eight (8) mathematics teachers of Achinakrom Senior High School for the interview and hundred

teachers from the five senior high schools in the municipality, to respond to the questionnaire. The schools were Achinakrom Senior High School, Onwe Senior High School, Ejisu Senior High and Technical School, Ejisuman Senior High School and Church of Christ Senior High School. Also, sixty-two (62) students were randomly selected for the achievement test to test whether there is an impact of peer tutoring on students' achievement test.

3.6 Data Collection Instrument

The instrument that was used in the study were test items which was used to collect data from the students, an interview guide and a questionnaire were used to collect data from teachers.

3.6.1 Achievement Test

A pre-test and a post-test were used to collect quantitative data from the students. In this study, the achievement test was used to measure whether or not students had improved academically. Ten objective questions and two subjective questions were included in the pre- and post-test. The allotted duration is 60 minutes. Each subjective item receives five marks, whereas each objective item receives one mark. Each and every item is based on the Ghanaian mathematics curriculum for senior high school. The pre-test was used to ascertain the mastery level of students. The post-test was administered after the peer tutoring among the mathematics teachers to ascertain the students' performance after the peer tutoring program.

3.6.2 Questionnaire

Structured questionnaires which consisted of closed-ended items were adapted from an already existing instrument. A questionnaire, according to Cohen and Tate (1989), is a self-concept tool used to collect data on factors of interest to research. The questionnaire was used because it is the quickest mode of gathering data from large group of respondents where confidentiality and anonymity are also assured. The questionnaire was developed from the existing modified works of Hooper, Mullis, and Martin, (2016) for peer tutoring and teaching quality, Enochs, Smith and Huinker, (2000) for teacher efficacy and Fogarty and Taylor (1997) for mathematics achievement. The instrument consisted of two sections. In the first segment, biographical information on the teachers was gathered, including the teachers' gender, age, marital status, level of education, and employment history. The second section was made up various questions that for peer tutoring, teacher efficacy, teacher quality and mathematics achievement. The instrument used contained thirty- seven (37) items closed- ended statements divided into four main sections based on the research questions. A 5-point Likert Scale was used (SA- Strongly Agree, 5: A- Agree, 4: N- Neutral, 3: D- Disagree, 2 and SD- Strongly Disagree, 1). The Likert scale has been determined to be one of the most effective tools for assessing attitudes and perceptions. This is because it allows respondents to rate how much they agree with a series of statements regarding how they feel about a topic (Webster-Stratton, Reid & Hammond, 2001).

3.6.3 Interview

The researcher conducted unstructured interviews to probe areas that cannot be explored using the questionnaire (Taylor, Bogdan, & DeVault, 2015). Some of these

interview questions will seek to find out from the mathematics teachers, how the peer tutoring program has affected their classroom practices and how their students have responded to their lesson presentations after the intervention program.

3.7 Validity and Reliability of Instruments

3.7.1 Validity of Instruments

The validity determines whether the research instrument measures what it should measure effectively or whether the results are accurate (Joppe, 2000). According to Heale & Twycross (2015), validity is the extent to which a concept is accurately measured in a study. Whether or not the instrument includes what it should in relation to the variable is referred to as content validity (Heale & Twycross, 2015). Face validity is the type of validity where experts are asked to verify if an instrument measure the content it is intended. In this study the test items were given to the head of department of Achinakrom Senior High School and two other mathematics teachers who has been teaching the subject for more than 20 years to do a face validity of the test items.

A proficient and seasoned mathematician evaluated the interview's face validity and offered potential teacher reactions. The interviewer was able to keep an eye out for noteworthy topics as they emerged in the teacher's responses by using the list to create response rubrics for every question. The response rubrics were modified and resubmitted to the expert for feedback following a pilot study involving two mathematics teachers; his suggestions were taken into consideration (McCray & Chen, 2012).

The questionnaire that was used to collect data on teacher efficacy is one adapted from the Mathematics Teaching Efficacy Beliefs Instrument (MTEBI) developed by Enochs

et al. (2000) which has been validated and used by many researchers including Swars, Daane & Giesen (2006) and Chang (2015).

3.7.2 Reliability of the Instruments

Reliability relates to the consistency of a measure, (Heale & Twycross, 2015). Kara & Çelikler (2015), explains reliability as the cohesion between the answers given to the test items. According to Heale & Twycross (2015), although reliability cannot be calculated with precision, it can be estimated using a variety of techniques. One of the three characteristics of reliability is homogeneity, often known as internal consistency. They defined homogeneity as the degree to which all of a scale's elements measure the same construct. One of the common ways through which Homogeneity is assessed is the use of the Cronbach's alpha test. Cronbach's alpha yields a result within the range of 0 to 1. A reliability score of 0.7 or higher is generally deemed acceptable. (Lobiondo-Wood & Haber, 2013). The reliability analysis is summarized in Table 1. The coefficients for peer tutoring, teacher quality, teacher efficacy and students' mathematics achievement are shown as 0.924, 0.726, 0.731, and 0.882 respectively. In summary, the reliability coefficients for the four measuring items employed in this study exceeded the minimum threshold value of 0.7.

Table 1: Cronbach Alpha Analysis

Construct	Cronbach Alpha	Number of Items
Peer tutoring	0.924	8
Teacher Quality	0.726	7
Teacher Efficacy	0.731	8
Students' mathematics achievement	0.882	10

Source: Field Survey (2023)

3.8 Method of Data Analysis

For open-coding qualitative data analysis, the researcher transformed the field notes generated by audio interviews into written documents (Glaser & Strauss, 1967). By analysing qualitative data, the researcher means a procedure in which transcribed, field notices, and other materials are systematically examined and arranged to produce results (Bogdan & Biklen, 2007). The data collected on mathematics teachers' perception on peer tutoring, teacher efficacy and teacher quality using the interview was analyzed to answer research question one, two and three using thematic analysis. The quantitative data collected using the test items was analysed using the IBM-SPSS software. An analysis was done to compare the means of the two sets of data from the pre-test and post-test using the **t-test**. The analysis of the data collected through the test items was used to answer the fourth research question. Thus, to determine whether peer tutoring among mathematics teacher has any effect on their students' academic performance. The data collected on mathematics teachers' perception on peer tutoring, teacher efficacy and teacher quality using the questionnaire was analyzed using regression analysis. The analysis of this data was used to support the findings of the analysis of the interview transcript.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.0 Overview

The data gathered through analysis in accordance with the objectives are presented in the chapter. The analysis starts with background information, data screening, frequency breakdowns, and percentages of the responder profile. Thematic analyses of the study's various variables are also included. The discussion of the results is covered in the second half of this section."

4.1 Background to the Data Analysis

Based on the suggested sample size of eight (8) respondents in the research methodology, the data were gathered using an interviewing guide. The eight (8) respondents were interviewed from the Achinakrom Senior High School and Onwe Senior High School. In this part, the respondents were described in terms of their gender, level of education, and their employment history. The researcher then had the data recorded and coded after it had been gathered. Tables with the coded identities for each respondent were used to present the demographic details. Codes were produced after reading the scripts. Using pertinent quotes from the respondents, the key themes that emerged from the transcripts of the interviews were noted and explored."

4.2 Demographic Analysis

The demographic profile of respondents was presented in terms of their: gender, educational qualification and work experience.

Table 2: Participant Demographics

Participant	Gender	Educational Qualification	Years of Experience
Participant A 1	Male	Bachelor's Degree	6 years
Participant A 2	Male	Bachelor's Degree	3 years
Participant A 3	Male	Master's Degree	Less than 1 year
Participant A 4	Female	Master's Degree	2 years
Participant A 5	Female	Bachelor's Degree	8 years
Participant A 6	Female	Bachelor's Degree	3 years
Participant A 7	Male	Master's Degree	2 years
Participant A 8	Male	Bachelor's Degree	12 years

Source: Field Work 2023

Table 2 presents the demographics of participants who were involved in the interview schedule according to their gender, educational qualification, and years of experience. Among these demographics, there were five (5) males and three (3) females. In terms of educational qualification, there were five (5) teachers with Bachelor's degree and three (3) teachers with Master's degree. In terms of years of teaching, five (5) teachers had taught for less than five years or with experience. There was one teacher with 6 years' experience of teaching and moreover, there was a teacher with 12 years' experience in teaching.

4.3 Preliminary Data Analysis

In this section, a thematic analysis was used. Following the interviewees' consent, the interviews were taped and transcriptions of the interviews were written. The data was confirmed and checked for accuracy using the triangulation method. To uncover common themes, triangulation involves analysing data from numerous sources on a given topic. (Creswell, 2009; Patton, 2014). Codes and themes were created once the

interviews were transcribed. The themes that were created from the transcripts of the interviews were cross-checked with other senior and junior colleagues. In order to determine whether the themes that were developed from the responses fit the ones under each category, they were examined. The transcribed interviews were used to create codes, which were then searched, examined, and identified. As a result, for every question, the recurring themes in the interviewees' responses were identified and highlighted. Additionally, to reinforce the discovered themes, quotes or statements from the respondents were utilised."

4.4 Thematic Data Analysis based on Objectives

The transcripts of the interviews "were reviewed, confirmed by the participants, and the strongest statements were emphasized. From these underlined passages, common concepts or topics were looked for, uncovered, and examined. For each group of findings, issues have been emphasized and examined if they are present in the answers provided by over 50 percent of the respondents. The themes have subsequently been named and recognized. The interviews were evaluated numerous times until the themes became saturated and no new concepts, aside from those already identified, could be produced under each area. To facilitate understanding, the categories that were developed based on the results of this qualitative analysis are offered under each of the objectives.

4.5 Mathematics Teachers' Perception on Peer Teaching among Mathematics Teachers

The study's participants were tasked with providing a precise and truthful assessment of their perception of peer teaching among mathematics teachers. Four (4) primary

questions were posed for the purpose of this research question to learn more about how teachers felt about peer teaching. In order to respond to the research question, similar responses from the data collected which have been organized into themes are provided. On the first question, "How valuable is the peer tutoring programme among mathematics teachers?" had the following theme as:

Bridging concept gaps

...provide more guidance as teachers learn and teach themselves in a small group to complete a task (Participant A6 and A1, refer to Table 2).

...I see peer tutoring has more great impact and should be practiced because by interacting with their peer tutees and responding to their varied needs, the peer tutors ended up mastering the mathematics task and by then have better achievement in the subject (Participant A3 and A2, refer to Table 2).

.... Well, the value of the peer tutoring programme is relevant and I support the implementation of the programme because it gives chance to teachers to take up the responsibility in assisting his fellow teachers through patience in understanding a mathematics concept (Participant A5 and A8, refer to Table 2).

On the second question, "In what ways can the peer tutoring programme serve as a means of professional development for mathematics teachers?" had the following theme as:

Building confidence

... Peer tutoring programme as a means of professional development provides confidence as they get experience in the process of the peer tutoring (Participant A4 and A2, refer to Table 2).

... I see peer tutoring serves as a bridge between teachers and teachers in the teaching and learning process as they learn mathematics. This is because it brings about the

development of self-esteem as they learn and make the teachers more successful in the teaching and learning of mathematics as they gain experiences (Participant A1 and A8, refer to Table 2).

On the third question, the findings revealed on "What personal gains did you get from the learning experience?" had the following theme as:

Creating an environment for team work and personal development

... I see the relevant of peer tutoring promote personal gain by strengthening the understanding of the mathematics concepts or topics and increases the confidence of the teachers (Participant A3 and A2, refer to Table 2).

... In fact, peer tutoring programme provides an avenue where teachers feels that they are supported by their colleagues in challenges they faced in teaching the concepts of mathematics. (Participant A4, refer to Table 2)

... I also think teachers gain personal experiences through peer tutoring programme because teachers feel their mistakes which they find it difficult in solving mathematics problem or a task are being solved among their colleagues (Participant A6, refer to Table 2)

On the fourth question under the research question about teachers' perception on peer tutoring programme, the findings revealed on "What will be your recommendation for peer tutoring as a form of informal training for mathematics teachers" had the following theme as:

Regularizing peer tutoring among mathematics teachers in schools

... I recommend that peer tutoring programme should be enforced in the school setting because it gives opportunity or establishes an environment where teachers work in a small group and learn how to work as a team and this action helps to increase their understanding of the content of mathematics (Participant A3 and A2, refer to Table 2).

... promotes critical thinking and problem-solving based learning among teachers and therefore, I recommend that peer tutoring programme should be practiced effectively (Participant A4 and A5, refer to Table 2).

... Peer tutoring programme should be part of the school system because it creates space for communication among the teachers in the learning environment, teachers' engagement in solving a problem, and personal skills as these teachers come together to achieve a one purpose of solving mathematics task.

To answer the research question, the findings revealed that there was a positive impact of peer teaching among mathematics teachers on mathematics teachers' perception. This is because the findings revealed that peer teaching among mathematics teachers promotes learning from colleagues, sharing ideas, promotion of team work and critical thinking, filling of a concept gap, boost confidence, and improves teachers' practices.

4.6 Effect of Peer Teaching among Mathematics Teachers on Teacher Efficacy

The study's participants were tasked with providing a precise and truthful assessment of the impact of peer teaching among mathematics teachers on teacher efficacy. Three (3) primary questions were posed for the purpose of this research question to learn more about how teachers felt about the impact of peer teaching among mathematics teachers on teacher efficacy. In order to respond to the research question, similar responses from the data collected which have been organized into themes are provided. On the first question, "How has the tutoring programme reinforced your skills to teach the mathematics topics discussed?" had the following theme as:

New pedagogical knowledge

... I see the application of peer tutoring has aided me the opportunity to differentiate my teaching methods which has improve my skills to teach the mathematics topics (Participant A2 A7, and A8, refer to Table 2).

... The application of peer tutoring has also informed me to be more effective in tackling students' difficulty or issues they have in mathematics so many diverse ways. That is, through peer tutoring, I am able to work with the students by guiding them through a mathematics questions and discussion methods as they work in small groups in the classroom to solve mathematics assignments or exercises (Participant A1, A4 and A5, refer to Table 2).

On the second question, the findings revealed on "How can the peer tutoring programme expose you to some of these better ways?" had the following theme as:

Learning from colleagues

... Through peer tutoring programme, it has informed me to assist students by organizing students in a small group in solving mathematics exercise or assignments in the mathematics class where I serve as a facilitator. This exposure has informed me that the less knowledgeable students who do not understand the concept in mathematics will be helped by his fellow colleague who understands better of the concept of mathematics as they work in a small group (Participant A2, A3 and A8, refer to Table 2).

... Well, the implementation peer tutoring has given me an exposure where I see that peer tutoring encourages teachers' study skills, teaching strategies and self-confidence as we learn from each other (Participant A2, A3 and A8, refer to Table 1).

On the third question, the findings revealed on "What approach did you learn from the peer tutoring programme to turn your *students* on to mathematics?" had the following theme as:

Student-centered approach

... I see the application of peer tutoring adopted the collaborative learning approach in the teaching and learning of mathematics (Participant A1 and A5, refer to Table 2).

... Peer tutoring makes the teacher not just teaching the mathematics concept while students are writing notes but, in this process, the teacher should be giving clues and guidance to students as they work on a mathematics problem or task in the mathematics classroom (Participant A3 and A4, refer to Table 2).

To answer this objective, the impact of peer teaching among mathematics teachers on teacher efficacy was seen as significant since teachers who responded to the interview guide questions described that peer tutoring impact teacher efficacy through differentiation of the teaching methods, peer tutoring encourages teachers' study skills, teaching strategies and self-confidence, and peer tutoring adopted the collaborative learning approach in the teaching and learning of mathematics.

4.7 Effect of Peer Teaching among Mathematics on Teacher Quality

The study's participants were tasked with providing a precise and truthful assessment of the impact of peer teaching among mathematics teachers on teacher quality. Four (4) primary questions were posed for the purpose of this research question to learn more about how teachers felt about the impact of peer teaching among mathematics teachers on teacher quality. In order to respond to the research question, similar responses from the data collected which have been organized into themes are provided. On the first question, "How important is it to collaborate with other teachers in planning and preparing instructional materials?" had the following theme as:

Improved teacher's classroom practices

... I see is very important to collaborate with other teacher in planning and preparing the instructional materials because this action results in the development of higher-level thinking order and mastery of the content which leads to the improvement of teaching and learning in the classroom topics (Participant A2 A7, and A8, refer to Table 2).

... I see collaboration with other teachers in planning and preparing instructional materials encourages the teachers to consider an alternative learning strategy that may be employed to bring teachers in the application of the peer tutoring approach for effective teaching and learning (Participant A3 and A4, refer to Table 2).

... well, collaboration with other teachers in planning and preparing instructional materials anticipate misconceptions and consider a different teaching method (Participant A1, A4 and A5, refer to Table 1).

On the second question, the findings revealed on "What in your opinion is the most appropriate way of solving examples in the course of teaching?" had the following themes as:

Discovery method and problem-solving approach

...I see the best way of helping students to understand mathematics in the teaching and learning in the classroom should be the use of small groups (Participant A1 and A2, refer to Table 2).

... the use of collaborative is the appropriate way of solving examples in the course of teaching (Participant A4, refer to Table 2).

... I support the idea of peer teaching while a student will be given the opportunity to teach his fellow colleagues in the mathematics class. In this case, the teacher only act as a facilitator who monitors the peer tutor in his/her delivery of the content (Participant A6 and A7, refer to Table 2).

On the third question, the findings revealed on "How necessary is it to assist students relate what they are learning in mathematics to their daily lives?" had the following themes as:

Develops students' interest in mathematics

... I see is very necessary to assist students because by giving them clues and related hints on a problem they are challenged with, they will find their way out to find a solution to the problem (Participant A2 and A8, refer to Table 2).

... Teachers' best way assist students is the most crucial part because this action develops students' interest and lower their perception that mathematics is difficult (Participant A1 and A5, refer to Table 2).

On the fourth question under the research question about the effects of peer tutoring among teachers on teacher quality, the findings revealed on "In your opinion what is the best way to teach a mathematics?" had the following themes as:

- Participative method
- Learner-centered method
- Discovery method and problem-solving approach
- Cooperative learning strategies

To answer this objective, the impact of peer teaching among mathematics teachers on teacher quality was seen as significant since the findings support that peer tutoring put the teacher in a position where the teacher may vary his teaching methods and anticipate misconceptions and consider a different teaching technique.

4.8 Effect of Peer Teaching among Mathematics Teachers on Students' Academic Performance in Mathematics

The achievement test was to determined the achievement level of teachers on the impact of peer teaching among mathematics teachers on students' academic performance. This test was consisting of some questions to be solved by students. This achievement test was conducted in two-fold consisting of a pre-test and a post-test. The post achievement test contained questions that were slightly different from the question in the pre - achievement test, but the level of difficulty of the questions were the same. Before and after the achievement test of respondents are presented in table 3

Table 3: Achievement Test of Pre-Test and Post-Test

		N	Mean	Std. Deviation	Std. Error Mean
Pair 1	PRE-TEST	62	10.8871	4.26232	.54132
	POST-TEST	62	14.6290	3.52152	.44723

Source: Researcher's Field Work (2023)

Table 3 explains the achievement test (pre-test and post-test) of sixty-two (62) students on the impact of peer teaching among mathematics teachers on students' academic performance. From the table, students' achievement test before the initiation (pre-test of achievement test) of the peer tutoring program had a mean score of 10.8871 and a standard deviation of 4.2623. The mean score after the initiation of the peer tutoring program had a mean score of 14.629 and a standard deviation of 3.5215. For the first-hand inference it seems that the difference between the scores of the post-test and the pre-test was really significance. The results from the post-test were more consistent

than the scores from the pre-test. Therefore, the mean score of post-tests was higher than the mean score of the pre-test. To test whether there is a significant difference on the impact of peer teaching among mathematics teachers on students' academic performance, regression analysis was calculated of the difference in their means of the post-test and the pre-test scores. Therefore, the null hypothesis was stated as $\mu_1 = \mu_2$ (there is no significance difference between students' achievement in peer teaching). Table 3 depicts the results of the independent t-test analysis.

Table 4: Difference of Means of Peer Teaching on Students' Achievement

	Paired Differences							
				95% Confidence Interval of the Difference				
	Mean	**Std. Deviation**	**Std. Error Mean**	**Lower**	**Upper**	**t**	**Df**	**Sig. (2-tailed)**
PRE-TEST – POST-TEST	3.742	1.889	.2400	-4.221	-3.262	15.59	99	.000

Dependent variable: students' achievement

Source: Researcher's Field Work (2023)

Table 4 defines the difference of means of peer teaching as an impact on students' achievement. The difference in the post-test and the pre-test had a mean score of 3.742 and a standard deviation of 1.889. From the analysis, the t-test score reported a value of 15.59>1.96 as suggested by Hair et al. (2010) and the it defines that the analysis was significant (0.000, p-value< 0.1). Therefore, we reject the null hypothesis (there is no significance difference between students' achievement in peer teaching) and accept the

alternate hypothesis that there is significance difference between students' achievement through the implementation of peer teaching among teachers.

A quantitative analysis was further applied to check the findings of the qualitative analysis. Based on this approach, a sample of one hundred (100) respondents were sampled from Achinakrom Senior High School and Onwe Senior High School where a closed-ended questionnaires were distributed to each for the quantitative analysis. Teachers' demographics are reported according to the age, gender, educational qualification and working experience. Table 4 depicts teachers' demographics

Table 5: Demographic Features of Respondents

Variable	**Category**	**Frequency (*N*)**	**Percentage (%)**
Age	21-30	33	33
	31-40	49	49
	41- 50	10	10
	Above 45 years	8	8
	Totals	*100*	*100.0*
Gender	Male	55	55
	Female	45	45
	Totals	*100*	*100.0*
Marital Status	Single	27	27
	Married	82	82
	Divorced	1	1
	Totals	*100*	*100.0*
Educational Qualification	Bachelor	85	85
	Masters	15	15
	Totals	*100*	*100.0*
Working Experience	Less than 5	23	23
	6- 10	40	40
	11 – 15	21	21

16 – 20	15	15
Above 20 years	2	2
Total	*100*	100

Source: Researcher's Field Work (2023)

From Table 5 presented, 55 (55.0%) of the study participants were males, whiles 45 (45.0%) were females. Out of the total sample, 33 (33.0%) were aged 21-30 years, 49 (49.0%) were aged 31-40 years, 10 (10.0%) were aged 41-50 years, and 8 (8.0%) were aged above 50 years. Clearly. In terms of marital status, 27 (27.0%) were single, 82 (82.0%) were married, and a single respondent as 1% was seen to be divorced. Results presented indicated educational qualification that is, employee with masters were 15 (15.0%), Bachelor's degree were 85 (55.0%). And also, working experience offered by respondents indicated that less than 5 years were 23 (23.0%), 6-10 years were 40 (40.0%), 11-15 years were 31 (31.0%), 16-20 years were 15 (15.0%) and above 20 years were 2 (2.0%).

4.9 Analysis of Data on the Research Questions

In this section, the results related to the study's specific objectives are presented. The data underwent quantitative analysis, encompassing both descriptive and inferential statistical techniques. These statistical methods were chosen because the responses to the variables were measured numerically using a unilinear scale. The closed-ended questions used to collect information about the concepts' concerns were scored on a five-point unilinear scale, with one representing the strongest disagreement and five indicating the strongest agreement. The study followed mathematical approximation methods for interpreting the mean scores, as recommended by Sarstedt and Mooi, (2018). Consequently, there are five potential responses: Strongly Agree (4.5–5.0),

Agree (3.5–4.4), Neutral (2.5–3.4), Disagree (1.5–2.4), and Strongly Disagree (1.0–1.4). The findings are presented as follows

4.10 Mathematics Teachers' Perception on Peer Teaching among Mathematics Teachers

This research question seeks to find from the respondents about their views on the teachers' perception on peer teaching among mathematics teachers. This was done using a closed-ended question where respondents were allowed to select from the numerous options, the teachers' perception on peer teaching among mathematics teachers. Respondents' views were coded and it was answered using the mean, and standard deviation from SPSS (version 23). Table 5 shows the results

Table 6: The Perception of Peer Tutoring Among Teachers

Variable items	Mean	Std. Deviation
Peer tutoring is an effective intervention for the improvement of content knowledge, and increase understanding of subject matter.	3.82	1.004
Peer tutoring is found to be effective in assisting teachers improve teaching practices in the classroom.	3.64	0.968
In peer tutoring, teachers work in one-on-one pair which increase academic commitment in the school environment.	3.74	0.957
Peer tutoring creates a friendly learning environment in the school.	3.71	1.088
Peer tutoring helps the teacher to engage all students of the classroom in learning activity according to their individual needs	3.45	1.107
Peer tutoring techniques are successful and effective for senior high school teachers.	3.43	0.827

Peer tutoring provides teachers an opportunity to enhance their social and behavioral abilities, including communication, sharing and cooperating with each other in the school.	3.64	0.968
Peer tutoring helps teachers to assist weak students to make active participation in the classroom	3.71	1.088
TOTAL	**3.54**	**1.001**

Source: Researcher's Field Work (2023)

Table 6 discusses teachers' perception on peer teaching among mathematics teachers. The mean and standard deviation were used to respond to this. Among the questions which were asked to answer this objective were "Peer tutoring is an effective intervention for the improvement of content knowledge, and increase understanding of subject matter." had a (Mean= 3.82, S. D= 1.004), "Peer tutoring is found to be effective in assisting teachers improve teaching practices in the classroom." had a (Mean= 3.64, S. D= 0.968), "In peer tutoring, teachers work in one-on-one pair which increase academic commitment in the classroom." had a (Mean= 3.74, S. D= 0.957), "Peer tutoring creates a friendly learning environment in the school" had a (Mean= 3.71, S. D= 1.088), "Peer tutoring helps the teacher to engage all students of the classroom in learning activity according to their individual needs" had a (Mean= 3.45, S. D= 1.107), "Peer tutoring techniques are successful and effective for high school teachers" had a (Mean= 3.43, S. D= 0.827), teachers' view on "Peer tutoring provides an opportunity to enhance social and behavioral abilities, including communication, sharing and cooperative with each other in the school" had a (Mean= 3.64, S. D= 0.968), and "Peer tutoring helps weak students to make active participation in the classroom" had a (Mean= 3.71, S. D= 1.088). From this analysis, the total mean and standard deviation was reported as 3.64 and 1.001 respectively. This explains that teachers' perception on

peer teaching among mathematics teachers was positive and significant, and that the analysis confirms that teachers support that peer tutoring affect students' performance. Since the total mean is greater than the midpoint value (3.0), it confirms that teachers' perception on peer teaching among mathematics teachers was positive by suggestion from Hair et al. (2010).

4.11 Effect of Peer Teaching among Mathematics Teachers on Teacher Efficacy

This research hypothesis seeks to find from the respondents whether or not there is a statistically significant effect of peer tutoring on teacher efficacy. This was answered using regression analysis from SPSS (version 23). Table 7 shows the results

Table 7: Effect of Peer Tutoring on Teacher efficacy

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	**Std. Error**	**Beta**	**T**	**Sig.**
1	(Constant)	2.395	.238		10.060	.000
	Peer tutoring	.401	.058	.400	6.877	.000

R=0.400, R^2=0.016, F=47.287, P-value=0.000

a. Dependent Variable: teacher efficacy

Source*: Field survey, 2023*

Regression model was performed to determine the effect of peer tutoring on teacher efficacy. The regression model was significant ($F = 47.287$, $p < .01$), with an R indicating that there is 40% of the effect of peer tutoring on teacher efficacy which can be explained by the independent variable (peer tutoring). Furthermore, the change in R

square was statistically significant indicating that peer tutoring has an effect on teacher efficacy, 0.016<0.05 level (2 tailed).

4.12 Effect of Peer Tutoring on Teacher Quality

This research hypothesis seeks to find from the respondents whether or not there is a statistically significant effect of peer tutoring on teacher quality. This was answered using regression analysis from SPSS (version 23). Table 8 shows the results

Table 8: Effect of Peer Tutoring on Teacher Quality

		Unstandardized Coefficients		Standardized Coefficients		
Model		**B**	**Std. Error**	**Beta**	**T**	**Sig.**
1	(Constant)	3.446	.124		27.690	.000
	Peer tutoring	.144	.030	.287	4.720	.000

R=0.287, R^2=0.028, F=22.278, P-value=0.000

a. Dependent Variable: teacher quality

Source: Field survey, 2023

Regression model was performed to determine the effect of peer tutoring on teacher quality. The regression model was significant (F = 22.278, p< .01), with an R indicating that there is 14% of the effect of peer tutoring on teacher quality which can be explained by the independent variable (peer tutoring). Furthermore, the change in R square was statistically significant indicating that peer tutoring has an effect on teacher quality, 0.028<0.05 level (2 tailed).

4. 12 Discussion of Results

4.12.1 Teachers' perception on peer teaching among mathematics teachers

Based on the findings, this present study was supported by Penuel, Fishman, Yamaguchi, and Gallagher (2007) who stated that most teachers had some form of discomfort when it is required of them to attend professional development programs that sought to enhance their teaching and learning practices. But rather, "professional learning communities" such peer tutoring among mathematics teachers should be encouraged in senior high schools as an option to "traditional professional development". In agreement with other research, the result of this study affirms that peer tutoring is valuable experience for teachers as it provides the opportunity for skill development (Defeo et al., 2022). According to the interview transcript, there is an indication that peer tutoring is a very valuable experience in the sense that it provides the opportunity to share ideas which helps to improve teaching and learning. According to Pharis et al., (2019), peer teachers shared their views relating to instructions, learning, cooperativeness and comprehensive class room practices.

It was indicated that peer tutoring among mathematics teachers creates the environment for teachers to learn from their colleagues. Teachers have the opportunity to clear misconceptions and also learn new and effective teaching and learning strategies. This is in agreement with the assertion by Pharis et al. (2019) who noted that school-based professional development like peer tutoring among mathematics teachers gave teachers the chance to engage in synergic interaction to freely deliberate about challenging topics and practical strategies. Shuilleabhain and Seery (2018) contend that for meaningful and effective transformation to take place in the classroom, it is imperative to foster a culture of collaboration among teachers. Such collaboration forms a crucial

part of teachers' ongoing learning journeys within their communities and is instrumental in addressing content gaps that may arise in certain subjects or topics. When teachers collaborate within a community, it creates a robust framework where individual educators can explore and reflect upon novel teaching and learning methodologies aligned with their specific school context, students, and culture (Dogan, Pringle & Mesa, 2016; Vescio, Ross & Adams, 2008). The ultimate goal is to determine what instructional approaches work best for students, a vision shared by both teachers and educational authorities.

While the concept of teamwork is prevalent in environments like the United States Army, it has been observed to have limited implementation within the academic realm (Charbonneau et al., 2010). An international review of related literature highlights that effective collaboration among peer teachers for lesson planning contributes significantly to the development of teachers' pedagogical knowledge. Furthermore, collaborative efforts foster a learner-centered approach to mathematics education (Dudley, 2013; Lewis, Perry & Hurd, 2009; Murata et al., 2012; Ni Shuilleabhain, 2016). Engaging in collaborative endeavors with peers, where the aim is mutual support, enables teachers to engage directly with the curriculum. This process involves delineating the objectives and goals of their teaching and crafting lessons that are intricately aligned with both the philosophical underpinnings and the content of the curriculum (Cajkler et al., 2014; Takahashi & McDougal, 2016). This collaborative ethos, akin to leaders empowering their subordinates to accomplish specific missions, resonates with teachers' interactions with students on a daily basis.

Peer collaborative work in lesson planning and design necessitates reflection on action, which empowers teachers to comprehend mathematical concepts—whether they are challenging or straightforward. This approach also encourages critical thinking among

students and fosters experiential learning (Myers, 2012). The capacity to continuously and thoughtfully evaluate what and how teachers teach, along with reflecting on their roles as educators to discern what best serves their students, is fundamental to effective teaching. In cases where certain mathematical concepts pose difficulties for teachers and students alike, collaboration and cooperation among teachers become indispensable in gaining a deeper understanding of these concepts and devising innovative instructional strategies.

4.12.2 The Effects of Peer Tutoring on Teacher Efficacy

Teachers develop confidence as a results of peer tutoring from the findings of this present study. Based on the findings, teachers share ideas, they get exposed to new strategies, fill concept gap and get better understanding of topics. This as a result boost their confidence in teaching mathematics topics. This aligned with the assertion of other researches Hoffman et. all. (2019), McLoughlin and Maslak (2003) and Fang and Ashley (2004), all have indicated that tutoring assist in enhancing confidence in teaching content. Okilwa and Shelby (2010) discovered that peer tutoring led to improved academic outcomes for students, regardless of their disability types. Calhoon and Fuchs (2003) examined the impact of Peer Assisted Learning Strategies (PALS) in secondary mathematics instruction and came to the conclusion that PALS programme participants demonstrated good performance and a deeper comprehension of mathematical concepts. Furthermore, Topping et al. (2011) employed cross-age peer tutoring to explore factors contributing to enhanced mathematical achievement. The study found that peer tutoring resulted in increased math proficiency and boosted self-confidence in both tutors and tutees. Additionally, motivation in mathematics classes

experienced an upswing according to McMaster, Fuchs, and Fuchs (2006), while Fuchs et al. (2002) highlighted the substantial positive impact of peer tutoring on mathematics achievement.

Peer tutoring and cooperative learning practices have also shown promise for students with learning difficulties in mathematics, leading to improved math scores. Rheinheimer (2000) reported significant improvements in student grades after receiving five hours of tutoring. Peer tutoring improved students' chances of accomplishing academic objectives, intellectual growth, and admittance to higher education, according to Dvorak (2001). In contrast to traditional lectures, peer tutoring encourages students to ask more questions and elevates their cognitive engagement by allowing them to convey their knowledge of a subject to a fellow classmate. Additionally, studies by Comerchero (2008) indicate a link between teacher self-efficacy and perfectionism, shedding light on how educators' confidence in their abilities relates to their pursuit of excellence.

Moreover, teacher self-efficacy has been associated with emotional intelligence, as demonstrated in the works of Moafian and Ghanizadeh (2009) and Rastegar and Memarpour (2009). These studies illustrate the intricate interplay between educators' emotional competencies and their perceived self-efficacy, emphasizing the multifaceted nature of effective teaching.

Conversely, teacher self-efficacy has shown a negative relationship with teacher burnout, as evidenced in research by Brouwers and Tomic. (2000) and Comerchero (2008). This implies that higher levels of self-efficacy may act as a protective factor against the emotional and psychological exhaustion often experienced by educators.

Tschannen-Moran, et al. (1998) assert that teacher self-efficacy is of paramount importance, as it is closely associated with effective teaching. They posit that effective teachers tend to possess a strong sense of self-efficacy, which contributes significantly to their pedagogical growth and development. This assertion underscores the critical role that self-belief plays in shaping teaching effectiveness. The complex relationship between self-efficacy, reward, and performance is also explored in recent research by Tzur, Ganzach, and Pazy (2016). Their findings imply that the level of reward involved determines how self-efficacy affects performance. In particular, self-efficacy has a favourable impact on performance when the stakes are high, while having a negative impact when the stakes are low. This demonstrates how self-efficacy is contextual and how it affects task performance.

4.12.3 The Effects of Peer Tutoring on Teacher Quality

Based on the findings on the import of the interview transcript indicated that peer tutoring among teachers helped teachers to be more student centered. Among the number of studies that support this current study is Vassay (2010) who investigated peer teaching in college mathematics and discovered that it has a major effect on a person's intellectual and moral values, including their capacity for self-expression, competence of different concepts, time management, and sense of responsibility, in addition to collaboration, self-discipline, independence, confidence in themselves, resourcefulness, and cooperation. In a study by Hervie & Winful (2019), it was established that lack of frequent inservice trainings among other factors contribute to the poor performance of teachers in Ghana. Therefore it can be established that peer tutoring as a form of professional development trainings improves teacher quality to

some extent. Additionally, teachers are often better equipped to identify students' weaknesses during their teaching and learning activities (Mamoon-Al-Bashir, 2016). Within classroom settings, teachers can offer various forms of feedback, including general feedback for the entire class to address issues such as time management and personalized feedback tailored to individual students.

Feedback systems are instrumental in achieving learning objectives and provide learners with autonomy in their educational journeys beyond standardized curricula. Teacher feedback holds a crucial role in helping students reflect on their capabilities and motivating them to address areas where they may be lacking (Mamoon-Al-Bashir, 2016). This type of feedback is an essential component of ongoing assessment during the teaching process. It serves to inform teachers whether their teaching aligns with classroom learning objectives. Effective utilization of feedback is pivotal, as it equips students with insights into their past performance and guides them on how to approach future activities.

In addition to feedback, effective communication and collaboration are recognized as vital qualities in teachers. As per Khan, Zia-ul-Islam, Khan, & Education (2017), communication skills involve transmitting messages with shared understanding within the context of the communication. These skills encompass listening, speaking, reading, and writing. Research conducted by Ehindero and Ajibade (2000) highlights that for effective teaching to occur, teachers must possess good communication skills, adept classroom management abilities, updated subject knowledge, and a positive personality. Effective communication skills enable teachers to simplify complex concepts and enhance comprehension among students. These skills are critical for successful knowledge transmission, classroom management, and interaction with students.

To tailor instruction to students' abilities and potential, teachers must employ communication skills that inspire and motivate students in their learning journey (Semir, 2018). Consequently, proficient communication skills are fundamental to students' academic success and their future professional accomplishments. Inadequate communication skills among teachers can hinder students' learning progress and impede their educational advancement. It is essential for students to grasp the difference between right and wrong, and this reliance on the teacher's communication skills is paramount within the classroom (Sherwyn, Michael, Osborn & Pearson, 2000). Effective communication minimizes the likelihood of misunderstandings during the teaching process. For effective learning, students must be attentive to their teacher's instructions during lessons. Communication is an active process that requires focus and the courage to engage with others and convey messages effectively.

4.12.4 Impact of peer teaching among mathematics teachers on students' academic achievement

Based on the findings, it has been affirmed that peer teaching exerts a substantial influence on students' academic performance. This current study aligns with the research of Wenglinsky (2000), who also confirmed that students taught by teachers who had received professional development training in higher-order thinking skills outperformed their peers in mathematics assessments. Additionally, there is evidence in the literature suggesting that teachers who have undergone professional development training can enhance their students' academic performance by approximately 21 percentage points (Yoon, Duncan, Lee, Scarloss, & Shapley, 2007).

Bowman-Perrot et al. (2013) conducted a meta-analysis examining the impact of peer tutoring on student performance and concluded that peer teaching is an effective

intervention regardless of factors such as dosage, grade level, or disability status, as indicated by the data. In South Africa, Tracey et al. (2007) conducted a study describing the experiences of students who participated in a cross-cultural peer teaching program in Port Elizabeth, involving a privileged private school and a township school.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.0 Overview

This section sought to offer an overview of the study's key findings according to the data analysis. This section includes advice for reporting some of the difficulties found in the research as well as the overall finding from the study.

5.1 Summary

The main purpose of the study was to investigate the impact of peer tutoring among teachers on teacher efficacy, teacher quality and the academic achievement of students in the senior high schools. The target population were teachers sampled from Achinakrom Senior High School and Onwe Senior High School. The study adopted an explanatory sequential mixed method approached. Random sampling aided in the selection of eight (8) teachers for the analysis of the qualitative data and one hundred (100) teachers from the population for the analysis of the quantitative data. The study also randomly selected sixty-two (62) students to test the effect of the peer tutoring among mathematics teachers on students' achievement. The study adopted the descriptive approach with quantitative approach to gather and analysed relevant data by means of quantitative approach and qualitative analysis was as a result of thematic analysis. The major findings have been outlined below:

5.1.1 Teachers' Perception on Peer Teaching among Mathematics Teachers

The finding of this study from the respondents view on the teachers' perception on peer teaching among mathematics teachers was significant. The findings thematic analysis revealed that teacher's perception is learning from colleagues, sharing ideas, promotion

of team work and critical thinking, filling of a concept gap, boost confidence, and improves teachers' practices. The quantitative analysis on teachers' perception on peer teaching among mathematics teachers was significant with a mean score as 3.54 and the standard deviation of were 1.001.

5.1.2 The Effects of Peer Tutoring on Teacher Efficacy

The findings on this study reported the effects of peer tutoring on teacher efficacy. The impact of peer teaching among mathematics teachers on teacher efficacy was seen as significant through the thematic analysis stated that peer tutoring encourages students' study skills, learning strategies and self-confidence, and peer tutoring adopted the collaborative learning approach in the teaching and learning of mathematics. The quantitative analysis on the impact of peer teaching among mathematics teachers on teachers' efficacy was seen as significant with a p-value of 0.000 from the regression analysis.

5.1.3 The Effects of Peer Tutoring on Teacher Quality.

The findings on this study reported the effects of peer tutoring on teacher quality. The impact of peer teaching among mathematics teachers on teacher quality was seen as significant through the thematic analysis the findings support that peer tutoring put the teacher in a position where the teacher may vary his teaching methods and anticipate misconceptions and consider a different teaching technique. The quantitative analysis on the impact of peer teaching among mathematics teachers on teachers' quality was seen as significant with a p-value of 0.000 from the regression analysis. Therefore, there was a positive effect of the implementation of peer tutoring influencing teaching quality.

5.1.4 The Effects of Peer Tutoring on Students' Performance.

The findings on this study reported the effects of peer tutoring on students' achievement. This was seen as statistically significant from the mean score of post-tests was higher than the mean score of the pre-test and from the regression analysis, we rejected the null hypothesis and the study was concluded that there is significance difference between students' achievement through the implementation of peer teaching among teachers. Therefore, the effect of peer tutoring on students' achievement in mathematics was significant.

5.2 Conclusion

The research findings have addressed the research questions in light of the main objective of this study, which was to evaluate the effect of peer tutoring among mathematics teachers on student academic progress.

1. Teachers' perception on peer teaching among mathematics teachers was significant.
2. The impact of peer teaching among mathematics teachers on teacher efficacy was seen as significant.
3. The impact of peer teaching among mathematics teachers on teacher quality was seen as significant.
4. The effect of peer tutoring on students' achievement in mathematics was significant.

5.3 Recommendations

The following suggestions were given based on the results of the study to improve the effect of peer tutoring among mathematics teachers on student performance.

i. Mathematics Head of Department (HOD) of all senior high schools are encouraged to organize in-service training for teachers on how to implement collaborative learning strategies in the classroom setting.

ii. Mathematics teachers should be well motivated and encouraged to engage in peer tutoring among themselves.

iii. Teachers must be motivated enough to enable them impact students' mathematics achievement. This motivation should be both intrinsic and extrinsic.

5.3.1 Further Research Recommendation

On the basis of the conclusions derived from the finding of this study, the researcher would like to suggest some recommendations that would be helpful for further research as

- This study was conducted only in Ejisu municipality in the Ashanti region of Ghana. It is recommended that a similar studies should be done in different districts to establish the findings.
- Also, similar studies should be conducted in other Senior High Schools taking samples from different schools and different subjects as well.
- Again, this study was conducted in the second cycle level of the Ghanaian educational system. It is recommended that a similar study is conducted in the basic and the higher levels of the Ghanaian educational system.

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APPENDIX A

QUESTIONNAIRE

AKENTEN APPIAH-MENKA UNIVERSITY OF SKILLS TRAINING AND ENTREPRENEURIAL DEVELOPMENT

QUESTIONNAIRE

Dear Teachers,

Please spend a few minutes responding to this questionnaire. This study seeks to investigate the impact of peer teaching among teachers (in the area of subject matter knowledge and pedagogical skills) on students' academic performance in senior high schools. This is purely an academic exercise; therefore, all responses will be given maximum confidentiality. There is no understanding, there is no wrong or right answer. You will spend about 30 minutes completing this questionnaire. Please tick [√] where your response is applicable.

SECTION A. DEMOGRAPHICS

1. Gender: Male [ ] Female [ ]
2. Age: 20 – 30 years [ ] 31 – 45 years [ ] Above 46 years [ ]
3. Work Experience: 1 – 5 years [ ] 6 – 15 years [ ] Over 15 years [ ]

SECTION B. PEER TUTORING IN MATHEMATICS

Teachers were to indicate their level of responds from 'strongly disagree' to 'strongly agree'.

SD- strongly disagree D- disagree N- neutral A- agree SA- strongly agree

S/N	**VARIABLE**	SA	A	N	D	SD
1.	Peer tutoring is an effective intervention for the improvement of content knowledge, and increase understanding of subject matter.					
2.	Peer tutoring is found to be effective in assisting teachers improve teaching practices in the classroom.					
3.	In peer tutoring, teachers work in one-on-one pair which increase academic commitment in the school environment.					
4.	Peer tutoring creates a friendly learning environment in the school.					
5.	Peer tutoring helps the teacher to engage all students of the classroom in learning activity according to their individual needs					
6.	Peer tutoring techniques are successful and effective for senior high school teachers.					
7.	Peer tutoring provides teachers an opportunity to enhance their social and behavioral abilities, including communication, sharing and cooperating with each other in the school.					
8.	Peer tutoring helps teachers to assist weak students to make active participation in the classroom					

SECTION C. TEACHER EFFICACY

Please indicate the extent to which you agree with the following statement regarding Teacher Efficacy. Respond using a Likert scale of **1=Strongly disagree, 2=Disagree, 3=Indifference, 4=Agree, and 5=Strongly agree.**

Teacher Efficacy	**SA**	**A**	**N**	**D**	**SD**
How often do your teachers provide clear explanations of the topics they teach?					
To what extent do you believe your teachers are dedicated to helping you succeed academically?					
Have you noticed an improvement in your understanding of the subjects taught by teachers who exhibit high efficacy?					
How would you rate the level of support and encouragement provided by your teachers in helping you overcome academic challenges?					
Do you believe that teachers' efficacy has an impact on students' motivation to learn?					
Teaching further enhances my efficacy in the classroom?					

SECTION D. TEACHING QUALITY IN MATHEMATICS

Teachers were to indicate their level of responds from ‘strongly disagree’ to ‘strongly agree’.

SD- strongly disagree D- disagree N- neutral A- agree SA- strongly agree

S/N	VARIABLE	SA	A	N	D	SD
1.	My teacher helps me with difficulties in mathematics					
2.	There is a good working climate during mathematics class					
3.	My teacher gives me interesting mathematics task					
4.	My teacher is easy to understand every mathematics concept					
5.	I know what my teacher expects from me					
6.	My teacher explains a topic again when we do not understand					
7.	My teacher does a variety of things to help us learn					
8.	My teacher has clear answers to my questions I asked in mathematics class					
9.	My teacher has to tell us to keep classroom instruction					

APPENDIX B

INTERVIEW QUESTIONS

1. How long have you taught mathematics in the Senior High School**?**
2. Gender
3. Do you teach Elective Mathematics or Core Mathematics?

Examining the perception of peer tutoring among teachers

4. How valuable is peer tutoring programme among mathematics teachers?
5. In what ways can peer tutoring programme serve as a means of professional development for mathematics teachers?
6. What personal gains do you get from the learning experience of peer tutoring?
7. What will be your recommendation for peer tutoring as a form of informal training for mathematics teachers?

Examining the effects of peer tutoring among teachers on Teacher Efficacy

1. How can peer tutoring programme increased your level of content knowledge?
2. How can peer tutoring programme reinforced your skills to teach the mathematics topics?
3. Why is it important to continually find better ways to teach mathematics?
4. How can peer tutoring programme expose you to some of these better ways?
5. What approach did you learn from the peer tutoring programme to turn your students on to mathematics?

Examining the effects of peer tutoring among teachers on Teacher Quality

6. Why is it important to collaborate with other teachers in planning and preparing instructional materials?
7. Why is it important to share your teaching experience with other colleagues?
8. What in your opinion is the most appropriate way of solving examples in the course of teaching?
9. Why is it necessary to assist students relate what they are learning in mathematics to their daily lives?
10. In your opinion what is the best way to teach a mathematics?

APPENDIX C

ACHIEVEMENT TEST

PRE-TEST QUESTIONS

1. Musah chooses a number at random from 1 to 20 inclusive, what is the probability that the number is divisible by 3?

A) $\frac{3}{20}$ B) $\frac{3}{10}$ C) $\frac{1}{5}$ D) $\frac{1}{4}$

2. Which of the following vectors is parallel to $\begin{pmatrix}-4\\12\end{pmatrix}$?

A) $\begin{pmatrix}-1\\-3\end{pmatrix}$ B) $\begin{pmatrix}-3\\1\end{pmatrix}$ C) $\begin{pmatrix}-1\\3\end{pmatrix}$ D) $\begin{pmatrix}3\\-1\end{pmatrix}$

3. M is the midpoint of JK. If the coordinates of J is $(-5,4)$ $and\ M\ is$ $(-2,1)$,find the coordinates of K.

A) $(-2,1)$ **B)** $(-1,-2)$ *C)* $(-1,2)$ D) $(1,-2)$

4. The cost price of an article is GHC600,000.00. It is sold at a profit of 20%. Find the selling price

A) GHC120,000.00 B) GHC480,000.00 C) GHC720,000.00 D) GHC900,000.00

5. An amount of GHC120,000.00 was shared between Ama and Kofi. If Ama received GHC30,000.00 more than Kofi, how much did Ama received?

A) GHC45,000.00 B) GHC480,000.00 C) GHC720,000.00 D) GHC900,000.00

6. If the product of two consecutive odd numbers is 195, find their sum.

A) 26 B)28 C) 32 D)34

7. Two apples and a coconut cost GHC3,100.00. An apple and two coconuts costs GHC2,600.00. What is the cost of a coconut?

A) GHC520.00 B) GHC700.00 C) GHC1,140.00 D) GHC1,200.00

8. Find the interior angle of a 12-sided regular polygon.

A) 30° B) 60° C) 150° D) 210°

9. Express 236 as a base 8 numeral

A)352_{eight} B) 354_{eight} C) 453_{eight} D) 540_{eight}

10. Solve the inequality $3x - 5(3 - x) < 1$.

A) $x < -2$ B) $x > -8$ C) $x < 2$ D) $x < 8$

THEORY

Q1) $3^x \times 9^y = 243 \; and \; 3^x \div 3^{2y} = \frac{1}{27}$ find (x+y)

Q2) If $110_x = 1020_{four}$ find the value of x

POST-TEST QUESTIONS

1. Zowi is x years old now. Five years ago, she was half as old as she is now. How old is she now?

A) 10 years B) 5 years C) $3\frac{1}{3}$ years D) $1\frac{2}{3}$ years

2. Expand $3(3y-1)(6y-5)$.

A) $54y^2-63y+15$ B) $54y^2-63y-15$ C) $54y^2-27y-15$ D) $54y^2-27y+15$

3. Simplify $\frac{x^2-5x-14}{x^2-9x+14}$

A) $\frac{x+2}{x-2}$ B) $\frac{x-2}{x+2}$ C) $\frac{x+7}{x-7}$ D) $\frac{x-7}{x+7}$

4. Simplify the expression $\frac{x+y}{x^{-1}+y^{-1}}$

A) $\frac{x}{y}$ B) xy C) $\frac{y}{x}$ D) $\frac{1}{y}$

5. Subtract 122_3 $from$ 1001_3

A) 112_3 B) 102_3 C) 12_3 D) 122_3

6. The n^{th} term of the sequence 5, 8, 11,…. Is 383. Find n

A) 125 B) 126 C) 127 D) 194

7. What is the 8^{th} term of the sequence 32, 16, 8,….?

A) 2^2 B) $2^{\frac{1}{2}}$ C) 2^{-2} D) 2^{-4}

8. Find the number of terms in the Arithmetic Progression (A.P) $2,-9,-20,\ldots.,-141$.

A) 11 B) 12 C) 13 D) 14

9. Find the gradient of the curve $y=2x^2-x-3$ at the point P, correct to the **nearest** whole number.

A) 6 B) 7 C) 8 D) 9

10. A straight line which intersects with the curve $y = 3x^2 + 4x - 7$ gives a solution of the equation $3x^2 - x - 8 = 0$. Find the equation of the line

A) $y = 5x + 1$ B) $y = -5x + 1$ c) $y = 5x - 1$ d) $y = -5x - 1$

THEORY

Q1). If $10x^2 - 9xy + 2y^2 = 10$ $find\ the\ ratio\ x{:}y$

Q2) if $\boldsymbol{a} = \begin{pmatrix} 2 \\ 3 \end{pmatrix}, \boldsymbol{b} = \begin{pmatrix} 4 \\ 5 \end{pmatrix} and\ \boldsymbol{r} = \frac{1}{2}(\boldsymbol{a} - \boldsymbol{b})$ find **r.**