UNIVERSITY OF EDUCATION, WINNEBA

TEACHER KNOWLEDGE FOR TEACHING ALGEBRA: THE CASE OF JUNIOR HIGH SCHOOL MATHEMATICS TEACHERS IN AKWAPIM-NORTH MUNICIPALITY OF GHANA

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DECLARATION

Student's Declaration

I, Rachael Simmons, declare that this dissertation, with the exception of quotations and references contained in published works that have all been identified and duly acknowledged, is entirely my own original work, and it has not been submitted, either in part or whole, for another degree elsewhere.

Signature: ……

Date: ……

Supervisors' Declaration

I, hereby declare that the preparation and presentation of this work was supervised in accordance with the guidelines for supervision of Dissertation as laid down by the University of Education, Winneba.

Principal Supervisor: Nixon Saba Adzifome (Ph.D)

Signature: ……

Date: ……...

DEDICATION

I dedicate this work to my children.

ACKNOWLEDGEMENT

I am deeply grateful to Nixon Saba Adzifome (Ph.D), my supervisor, for his unwavering support, invaluable guidance, and constructive feedback throughout this research journey. His insightful suggestions, encouragement, and dedication have been instrumental in shaping this work, and I sincerely appreciate his patience and commitment to my academic growth.

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ABSTRACT

The purpose of this study was to assess Junior High School Mathematics teachers' knowledge and confidence for teaching algebra in the Akwapim-North Municipality of Ghana. Guided by four research questions, the study employed a mixed method approach, using a sequential explanatory as its design. The sample size was 83 JHS Mathematics teachers. These teachers were selected through a census frame during the quantitative phase. Purposive sampling in a form of homogeneous sampling technique was used to select teachers for the qualitative data. Data were collected using a structured questionnaire and semi-structured interview guide. Quantitative data analysis techniques, including simple frequency counts, percentages, mean, and standard deviation, ANOVA test was used utilized to analyze the survey data. Thematically analysis was used for interview data. The study found that majority of JHS mathematics teachers (57.8%) in the Akwapim-North Municipality have a moderate level of content knowledge for teaching algebra. Also, the pedagogical approaches used by these teachers in teaching algebra include group work, verbal explanation, class discussion, and demonstration using traditional resources. Findings of the study revealed that teachers reported high confidence level in teaching algebra. However, challenges, such as difficulty in translating algebraic word problems into arithmetic forms, inadequate instructional resources, limited professional training were reported for the teaching of algebra. Lastly, regardless of their years of experience, the teachers exhibit similar levels of confidence in teaching algebra. The study recommends that the Akwapim-North Municipal Education Directorate run professional-development workshops aimed at deepening teachers' algebra content knowledge and practical teaching strategies. Also, to address the challenges faced by JHS mathematics teachers in teaching algebra, the Municipal Education Office can resort to external funding engagement from NGOs for adequate instructional resources

CHAPTER ONE

INTRODUCTION

1.0 Overview

This chapter discusses the background to the study, statement of the problem, purpose of the study, research objectives, research questions, hypothesis, significance of the study, study delimitations and finally organisation of the study.

1.1 Background to the Study

Mathematics is a compulsory subject in Ghanaian basic and senior high schools, receiving significant emphasis due to its crucial role in socio-economic development (Noor & Kori'ah, 2022). The importance of mathematics stems from its widespread applications in everyday life and its vital contribution to advancements in science and technology (Gravemeijer et al., 2017; Surya et al., 2017). Learning mathematics equips students with essential skills that are valuable both academically and practically. It fosters abilities such as logical thinking, analytical reasoning, systematic problem-solving, critical evaluation, and creative thinking, as well as the capacity for collaborative work (Lince, 2016). These skills are not only fundamental to academic success but also to personal and professional development. This comprehensive role of mathematics is why it is taught continuously from elementary through to higher education (Susana, 2017), ensuring that students develop a robust understanding of mathematical concepts and their applications.

Among the concepts in Mathematics is Algebra, Sibgatullin et al. (2022) argued that the study of Algebra often involves the process of generalizing arithmetic operations, and as it gets more complex, it deals with unknown quantities. Schliemann et al. (2013) and Stephens et al. (2015) identify five categories of algebraic thinking: (a) generalization and formulation of arithmetic operations, (b) manipulation and

transformation of equality problems through inverse operations and principal syntax, (c) analysis of mathematical structures, (d) understanding relations and functions, including numbers and letters, and (e) algebraic language and representation. According to Yildiz and Yetkin Özdemir (2021), algebra involves equations requiring relational thinking, word problems starting with unknown values, symbols and shapes, and verbal statements representing mathematical relationships, which all provide opportunities for students to develop algebraic thinking. For example, engaging with number sentences helps students develop relational thinking and better understand how to maintain equality when solving equations with unknowns. Similarly, making connections with verbal statements representing mathematical relationships (e.g., each car has four wheels) helps students understand that variables can represent varying quantities. Algebra also includes variables, algebraic expressions, and equations. The concept of a variable is crucial for algebraic thinking and marks the transition from arithmetic to algebra (Blanton et al., 2017; Knuth et al., 2016). Developing a solid understanding of variables and equality is closely linked to how students conceptualize algebraic expressions and equations (Blanton et al., 2018; Weinberg et al., 2016).

In the Standards Based Mathematics Curriculum for Ghana, the study of Algebra involves forming expressions, performing operations on them, simplifying, factorizing, solving and graphing of linear equations involving binomials and fractions and inequalities, and performing change of subjects. This instruction begins at the junior high school level and continues into senior high school as a core aspect of mathematics (Baidoo & Ali, 2023). According to the Ministry of Education (2020), at the Junior High School (JHS) level, the study of algebra is divided into three main sub-strands: Patterns and Relations, Algebraic Expressions, and Equations and Inequalities. In Patterns and Relations, students learn to recognize and analyze patterns and

relationships between numbers and variables, which helps them predict and generalize mathematical relationships. The Algebraic Expressions sub-strand focuses on formulating, manipulating, and simplifying algebraic expressions, allowing students to represent real-world situations and perform operations to solve problems. Lastly, in Equations and Inequalities, students are trained to solve and interpret both linear equations and inequalities, both algebraically and graphically, and to apply these solutions to real-world contexts (Ministry of Education, 2020). Together, these sub-strands provide a comprehensive foundation in algebra, equipping students with the skills needed for more advanced mathematical concepts.

Unfortunately, for over a decade, learners in Junior High Schools in Ghana have consistently shown weak skills in algebra and its applications in the Basic Education Certificate Examination (WAEC, 2011-2015, 2017, 2019, 2021). Chief Examiners' reports for mathematics reveal specific algebra difficulties, such as struggling with tasks involving more than one variable, incorrectly expanding brackets (especially those with multiple terms or exponents), weak handling of tasks involving fractions, incorrect simplification of algebraic expressions, and improper application of the order of operations. These difficulties indicate that learners lack mastery in algebra, supporting claims that they face significant challenges with algebra tasks (Musi, 2023; Chaudhary, 2022; Matzin & Shahrill, 2015), which greatly impact their overall performance in mathematics (Niringiyimana & Maniraho, 2023; Ladele, 2013).

In a study conducted by Baidoo and Ali (2023) that investigated junior high school students' knowledge of algebra based on two contexts: mathematical and real-life, found that solving algebraic problems was very difficult for most junior high school students. The challenge was more prevalent for algebraic problems that involved real-life context. Similarly, in a recent study conducted by Osei and Agyei (2024) to

examine the algebra knowledge and difficulties of Junior High School learners in public and private schools in Ghana, findings revealed a continuous decline in average scores and the number of learners operating at higher levels of the dimensions of algebra thinking. A shocking revelation was that particularly, public school learners demonstrated proficiency up to the Evaluating level, whilst private school learners exhibited proficiency up to the Creating level, with private school learners exhibiting higher knowledge across all six levels and the overall algebra knowledge as compared to their counterparts in public schools.

One of the main factors contributing to this issue is teachers' knowledge. Researchers suggest that teachers' knowledge impacts their teaching practices (Copur-Gencturk, 2015; Hoover et al., 2016; Spangenberg, 2021), which in turn affects students' understanding of algebra (Huang & Kulm, 2012; Tchoshanow et al., 2017; Wasserman, 2015). For this reason, Yildiz and Yetkin Özdemir (2021) argued that teacher knowledge is particularly important in school mathematics to enhance the meaningful learning of algebra. They further noted that developing a solid understanding of algebra requires teachers to unpack the meaning underlying the basic concepts, make clear and explicit distinctions among concepts, and facilitate students to connect these concepts with their prior knowledge and understandings in arithmetic. In a confirmatory statement, Shulman (as cited in Donkor, 2021) said that "… *the teacher must remain the key. The literature on effective schools is meaningless; debates over educational policy are moot, if the primary agents of instruction are incapable of performing their functions well. No microcomputer will replace them, no television system will clone and distribute them, no scripted lessons will direct and control them, no voucher system will bypass them*" (p. 504).

Teacher knowledge in the context of this study refers their knowledge of the subject matter as well as their knowledge of how to teach algebraic concepts as s defined by Ball et al. (2005; 2008). Subject matter knowledge, or content knowledge, involves three components: (a) common content knowledge, which includes mathematical knowledge and skills not specific to teaching, and (b) specialized content knowledge, which pertains to different ways of representing mathematical content and explaining mathematical rules and procedures specific to teaching and knowledge of the mathematical horizon, which talks about awareness of how mathematical topics are related over the span of mathematics included in the curriculum, meaning the knowledge that allows the teacher to establish the way in which the mathematical contents are related to other contents of the curriculum (Ball et al., 2005; Ball et al., 2008; Hill & Ball, 2004; Hill et al., 2008). For instance, knowing how to solve an equation with one unknown exemplifies common content knowledge, while understanding the various methods for solving a system of linear equations with two unknowns (such as elimination, substitution, and graphing) illustrates specialized content knowledge. Ball's framework of pedagogical content knowledge includes three areas: Knowledge of Content and Students, which involves a deep understanding of the subject and awareness of student misconceptions; Knowledge of Content and Teaching, which focuses on selecting and using effective teaching strategies; and Knowledge of Content and Curriculum, which includes understanding how the content integrates into the broader curriculum and connects with students' previous and future learning (Ball et al., 2005; 2008).

Surprisingly, many studies have revealed that teachers often lack the necessary knowledge to teach algebra effectively (Reckase et al., 2015; Stephens et al, 2015; Watkins, 2018). These studies show that teachers have a limited understanding of

fundamental algebraic concepts such as variables, equality, algebraic expressions, and equations. Teachers often define algebra simply as the "use of letters and symbols" and lack a relational understanding of the equal sign. They do not use algebraic relationships in their teaching and typically focus on procedural knowledge rather than offering conceptual explanations. Mewborn (2003) noted that while teachers might have some mathematical knowledge, they often lack a deep conceptual understanding of the subject. Many mathematics teachers are proficient in routine procedures but do not grasp the underlying concepts that support these processes, making it difficult for them to effectively teach these concepts to students. However, teachers with a strong foundation in algebraic knowledge are better at solving problems using various methods and adapting to different contexts (Black, 2008). They can also identify and address errors and misconceptions in students' understanding. This suggests that the knowledge teachers have greatly affects students' performance (Wilmot et al., 2018; Yarkwah, 2017). Research consistently shows that teachers' content knowledge is often inadequate for providing effective instruction in modern classrooms (Ball, 2003b; Mewborn, 2003), which negatively impacts students' overall performance in subjects like mathematics.

Considering the correlation between teachers' knowledge and the success of their learners, this study was conducted to investigate the knowledge teachers possesses for the teaching of algebra in the Akwapim-North Municipality of Ghana.

1.2 Statement of the Problem

Algebra is one of the four key strands of Ghanaian standards-based Mathematics curriculum across all levels of the basic schools (Ministry of Education, 2020). Its teaching is crucial for learners' excellent performance in mathematics and its applications in science, statistics, business and 2lst century technology (Osei & Agyei,

2024). Due to this, algebra has become the gatekeeper, foundation (Stoelinga & Lynn, 2013; and the language of mathematics (Osei & Agyei, 2023). Consequently, learners who have weak algebra knowledge struggle to excel in mathematics as reported in various studies (Osei & Kubi, 2022; Osei, 2020; Makonye & Stepwell, 2016).

In the Akwapim-North Municipality, the performance of students in mathematics has been a challenge. Analysis of the pupils BECE results over the past ten years, shows that 53% of students who took the Basic Education Certificate Examination (BECE) in this area received grades between six (credit) and nine (fail). For example, in 2019, 2,641 students took the BECE, with 1,407 in 2010, and 1,983 in 2019. Of these, 1,024 students, or 52%, received grades six to nine. Similarly, in 2021, out of 2,049 candidates, 1,418 students, or 69%, received these grades. This trend continued in 2022 with 1,983 students taking the BECE and 52% receiving grades six to nine. In 2009 and 2008, 53% and 54% of students, respectively, fell within this grade range. This consistent poor performance in mathematics, a core subject, suggests that significant improvements are needed to help students gain entry into Senior High School.

Similarly, Amoah et al. (2023) conducted a study on the attitudes of students and teachers towards mathematics in the Akwapim-North Municipality. The study found that most learners had little interest in mathematics and performed poorly, making it difficult for them to solve mathematical problems. Key factors contributing to this poor performance included the inability of mathematics teachers to motivate students, the lack of use of teaching and learning materials (TLMs) by some teachers, and insufficient homework assignments in mathematics. Addressing these issues is crucial for improving student success and interest in mathematics. Therefore, the researcher decided to focus on algebra, a foundational component for success in

mathematics, and the knowledge teachers possess to effectively teach this concept to their learners. By addressing these factors, the aim is to enhance both the teaching and learning experiences in mathematics.

There is a wealth of studies on algebra and its teaching. In non-Ghanaian contexts, researchers such as Pincheira & Alsina (2021), Yılmaz-Tığlı (2023), Yilmaz & Erbaş (2017) in Turkey, and Watkins (2018) in the USA have investigated teachers' knowledge for teaching algebra. However, these studies were not conducted within Ghanaian settings.

In Ghana, research has primarily focused on students' knowledge of algebra (Osei and Agyei, 2024; Aforklenu, 2013). Unlike these, the current study centers on teachers rather than students. Previous studies have also examined senior high school teachers' knowledge for teaching algebra (Donkor, 2020, in Ahafo and Central Region; Yarkwah, 2017, in three regions) and pre-service teachers' knowledge for teaching algebra (Entsie, 2021, in Central Region). In contrast, the current study focuses on in-service teachers teaching mathematics at the junior high school level.

Few studies have explored the algebra knowledge of teachers at the junior high level (Osei & Kubi, 2022; Osei and Agyei, 2023 in the Ahafo Region). All of these studies used survey research designs and the KAT model, while the current study employs Ball's (2008) model of Mathematics Teacher Knowledge for Teaching.

In the Akwapim-North Municipality, previous studies, such as Amoah et al. (2023), have examined teachers' attitudes towards student performance in mathematics. Therefore, a mixed-method study focusing on teacher knowledge for teaching algebra in the unique context of the Akwapim-North Municipality remains unexplored. This gap highlights the necessity of the current study.

1.3 Purpose of the Study

The purpose of this study was to evaluate Junior High School mathematics teachers' algebra content knowledge, pedagogical content knowledge, and self-reported confidence for teaching algebra and to identify specific knowledge gaps and instructional challenges in the Akwapim-North Municipality of Ghana.

1.4 Objectives of the Study

The objectives of this study were to;

1. Assess JHS mathematics teachers' level of content knowledge for teaching algebra in the Akwapim-North Municipality.
2. Explore JHS mathematics teachers' pedagogical approaches in teaching algebra in the Akwapim-North Municipality.
3. Rate JHS mathematics teachers' level of confidence in teaching algebra in the Akwapim-North Municipality.
4. Identify the challenges that confront JHS mathematics teachers in teaching algebra in the Akwapim-North Municipality.

1.5 Research Questions

The study was guided by these research questions:

1. What is the level of content knowledge for teaching algebra among JHS mathematics teachers in the Akwapim-North Municipality?
2. What pedagogical approaches do JHS mathematics teachers employ in teaching algebra in the Akwapim-North Municipality?
3. How confident are JHS mathematics teachers in teaching algebra in the Akwapim-North Municipality?
4. What challenges confront JHS mathematics teachers in teaching algebra in the Akwapim-North Municipality?

1.6 Null Hypothesis

H_0: There is no statistically significant difference between teachers' years of experience and their confidence for teaching algebra in the Akwapim-North Municipality.

1.7 Significance of the Study

The findings of this study would benefit teachers, pupils and stakeholders within the Akwapim-North Municipality in several ways as follows: For Mathematics teachers, this findings from the study would help in their reflection of their instructional practices and insights into their content and pedagogical knowledge, self-confidence, and challenges when it comes to teaching algebra. This, in turn will help them to improve upon their algebra teaching practices. Additionally, the findings would benefit the Akwapim-North Municipal Education Directorate. This is because the findings can inform educational policymakers in within the area and beyond about the specific needs and challenges in teaching algebra. It is hoped that through this, they would develop and implement targeted policies and interventions. Lastly, this study will add to the existing literature and contribute to the broader understanding of algebra teaching in Ghana. Consequently, it will serve as a reference material for future researchers, laying a foundation for further investigations on the teaching of algebra in Ghana and beyond.

1.8 Delimitation of the Study

This study has specific boundaries. Firstly, it focuses on Junior High School (JHS) mathematics within the Akwapim-North Municipality. Therefore, teachers of other subjects were excluded from this study. Similarly, JHS mathematics teachers from other municipalities were also exempted. Lastly, this study focuses on teachers' knowledge; both content and pedagogical, their self-confidence, and the challenges

they face in teaching the concept of algebra in mathematics. Hence, other aspects of the teachers' instructional practices aside from these constructs were not included.

1.9 Definition of Terms

Algebra:	In this study, algebra included patterns and relations, algebraic expressions, and equations and inequalities as defined by the Ghanaian common core mathematics curriculum for JHS.
Content knowledge:	In this study, content knowledge refers to teachers' understanding of algebraic topics and their ability to solve related problems.
Pedagogical Approaches:	In this study, pedagogical approaches refers to the understanding teachers have about the methods and strategies for effectively teaching algebra to learners.
Confidence:	In this study, confidence refers to teachers' beliefs and convictions about their own abilities to teach algebra effectively to learners.

1.10 Organization of the Study

This research is organized into five main chapters, each of which is further divided into sub-headings. Chapter One serves as an introduction to the study, addressing topics such as an overview, the background of the study, the statement of the problem, the study's purpose and objectives, research questions, delimitations, list of abbreviations as well as the study's organization. Chapter Two provides a comprehensive review of the relevant literature, covering theoretical, conceptual, and empirical perspectives. The study is grounded in the theoretical frameworks of

emotional intelligence models. Additionally, various empirical studies were reviewed to support this research. Chapter Three outlines the methodology employed in the study, including the research design, study area, population, sampling, instrumentation, data collection procedures, data analysis methods, and ethical considerations. Chapter Four focuses on data presentation and analysis, wherein collected data were analyzed and discussed in relation to the study's research questions. Chapter Five provides a synopsis of the study, summarizing the findings, conclusions, and recommendations based on the study's findings.

CHAPTER TWO

REVIEW OF RELATED LITERATURE

2.0 Overview

This chapter reviews related existing body of literature on algebra and its teaching in schools. The review centered on these thematic areas: theoretical foundations of teacher knowledge and self-efficacy, defining algebra and its importance in education, components of teacher knowledge for algebra instruction, pedagogical approaches and instructional tools for teaching algebra, teacher self-confidence (self-efficacy) in mathematics teaching, challenges in teaching and learning algebra, synthesis of empirical evidence and identification of research gaps

2.1 Theoretical Framework

Three theories served as the theoretical framework. These were Ball, Thames, and Phelps (2008) Model of Mathematical Knowledge for Teaching (MKT), Ferrini-Mundy et al. (2005) Knowledge of Algebra for Teaching Framework, and Bandura's (1977) self-efficacy theory.

2.1.1 Ball et al.'s Model of Mathematical Knowledge for Teaching (MKT)

Ball, Thames, and Phelps (2008) created a model for teachers' mathematics knowledge (MKT) that shows Subject Matter Knowledge (SMK) and Pedagogical Content Knowledge (PCK) as two parts of an oval-shaped diagram. The left side of the oval represents SMK, which includes three parts: Common Content Knowledge (CCK), Horizon Content Knowledge (HCK), and Specialized Content Knowledge (SCK). Similarly, PCK is made up of three parts: Knowledge of Content and Students (KCS), Knowledge of Content and Teaching (KCT), and Knowledge of Curriculum (See Figure 2.1).

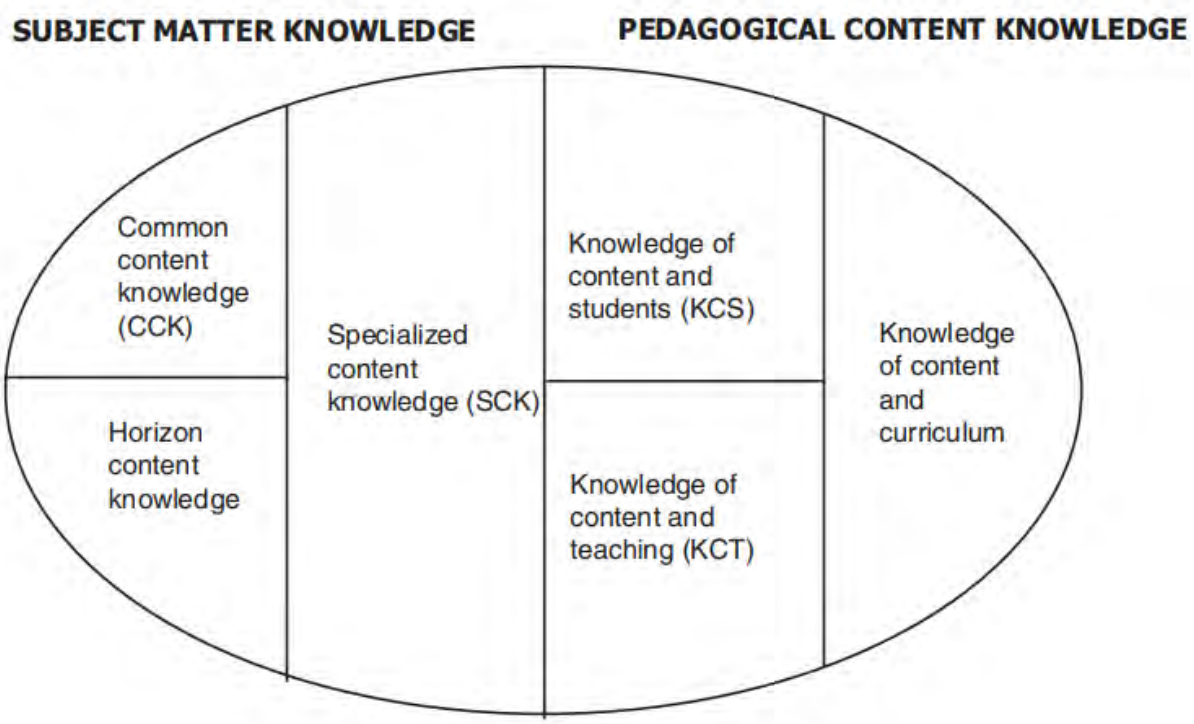

Figure 2.1: Domains of Mathematical Knowledge for Teaching (Ball et al., 2008, p. 403)

These aspects are further discussed below:

Content Knowledge is divided into three types:

Common Content Knowledge (CCK): This is the "mathematical knowledge and skills used in settings other than teaching" (Ball et al., 2008, p. 399). It means the basic mathematics knowledge anyone can learn through education and that anyone might use in everyday situations involving mathematics.

Specialized Content Knowledge (SCK): This is "mathematical knowledge and skills unique to teaching" (Hill et al., 2008, p. 400). It includes knowledge specific to teachers, such as how to correctly represent mathematical ideas, explain common rules and procedures, and analyze and understand different ways of solving problems.

Horizon Content Knowledge (HCK): This is the "awareness of how mathematical topics are related across the whole range of mathematics included in the curriculum"

(Ball et al., 2008, p. 399). It helps teachers understand how different mathematics topics connect to each other and to other subjects in the curriculum.

Pedagogical Knowledge of Content includes:

Knowledge of Content and Students (KCS): This combines understanding of mathematics content with knowing how students think about and learn that content (Pincheira & Alsina, 2021). It allows teachers to anticipate students' questions, attitudes, and difficulties.

Knowledge of Content and Teaching (KCT): This combines knowledge of teaching methods with mathematics knowledge (Santagata & Lee, 2019). It means understanding how to teach mathematics in a way that helps students learn effectively, integrating both the subject and teaching techniques.

Knowledge of Curriculum: This includes understanding all the programs designed for teaching specific subjects and topics at different educational levels and the instructional materials used in those programs (Santagata & Lee, 2019). It involves knowing the guidelines and approaches for teaching mathematics according to the curriculum.

2.1.2 Knowledge of Algebra for Teaching (KAT) Framework

The Knowledge of Algebra for Teaching (KAT) framework was established by researchers including Robert Floden, Joan Ferrini-Mundy, Raven McCrory, Mark Reckase, and Sharon Senk at Michigan State University in 2005. The framework outlines the mathematical understanding required for effective algebra instruction (Watkins, 2018). Research (McCrory et al., 2012; Wilmot, 2016; Wilmot et al., 2018) indicates that essential knowledge for teaching algebra includes School Algebra

Knowledge (SAK), Advanced Algebra Knowledge (AAK), and Algebra Teaching Knowledge (ATK). The researchers involved in developing the KAT framework have shown that these three types of knowledge are not arranged in a strict hierarchy and do not exist on a continuum with clear-cut boundaries. Instead, their boundaries are vague and interconnected in various ways (Ferrini-Mundy et al., 2005). Additionally, it is crucial to understand that the integration of these three knowledge types results in a more comprehensive form of knowledge, referred to as Pedagogical Content Knowledge in Algebra. This enhanced knowledge improves teachers' ability to effectively convey algebraic concepts to students, thereby positively impacting their mathematical performance. Figure 1 illustrates the relationship among the three types of knowledge and the advanced knowledge that emerges from their combination.

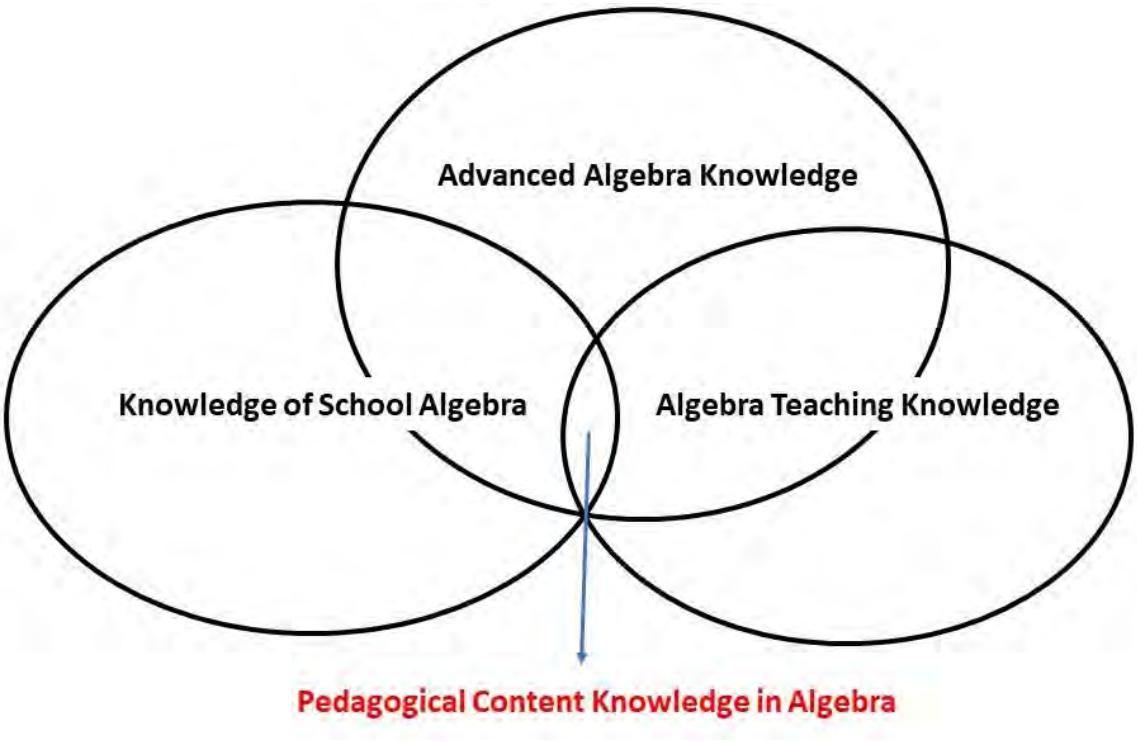

Figure 2.2: The types of Algebra Knowledge (Ferrini- Mundy et al., 2005; Willmot et al., 2018)

The components of algebra knowledge are explained below:

School Algebra Knowledge (SAK): School Algebra Knowledge is defined as the algebra topics that are part of the school curriculum (Reckase et al., 2015; Wilmot, 2016). Watkins (2018) explains that this type of knowledge means teachers need a thorough understanding of the algebra topics they teach, such as solving linear and quadratic equations. This understanding is known as Common Content Knowledge (CCK). The National Council of Teachers of Mathematics (2000) provides guidelines for what should be included in school algebra. According to Stein et al. (2011), different schools may teach algebra in different ways based on their specific needs and goals. In Ghanaian Junior High Schools, the algebra content covered under school algebra knowledge is found in the curriculum, textbooks, workbooks, and pamphlets. This study measures teachers' school algebra knowledge based on the algebra topics outlined in the Junior High School mathematics curriculum in Ghana.

Advanced Algebra Knowledge (AAK): Advanced Algebra Knowledge includes additional mathematical understanding from college-level courses (McCrory et al., 2012; Reckase et al., 2015; Wilmot, 2016) and the use of school algebra in other areas of mathematics (Osei & Kubi, 2022). The Conference Board of the Mathematical Sciences (2012), Reckase et al. (2015), and McCrory et al. (2012) describe Advanced Algebra Knowledge as going beyond basic school algebra, giving teachers a deeper understanding of different mathematical ideas and their uses. This type of knowledge also includes knowing different ways to define, generalize, and extend well-known mathematical theorems, which helps teachers develop a more advanced perspective on mathematics (Usiskin et al., 2003). Wilmot (2019) points out that topics like operations with numbers, sets, and algebraic expressions involve advanced algebra knowledge. In this study, teachers' advanced algebra knowledge was assessed based on how they

apply and expand on school algebra in other areas of mathematics as outlined in the Junior High School mathematics curriculum in Ghana.

Algebra Teaching Knowledge (ATK): Algebra Teaching Knowledge is the specific teaching skills needed for teaching algebra, which are not usually covered in advanced mathematics courses (Reckase et al., 2015; McCrory et al., 2012). This knowledge includes understanding what makes certain algebra concepts hard for students to learn (Reckase et al., 2015), recognizing students' mistakes (Osei & Kubi, 2022), linking these mistakes to specific misunderstandings, and finding ways to address these issues (Donkor, 2021; McCrory et al., 2012; Yarkwah, 2017). In this study, the Algebra Teaching Knowledge of Junior High School mathematics teachers was evaluated based on their ability to identify and connect students' mistakes to specific misconceptions and suggest effective ways to help students learn better.

2.1.3 Bandura's Self Efficacy Theory

Self-efficacy, a central concept in Bandura's (1977, 1997) Social Cognitive Theory, refers to an individual's belief in their ability to execute tasks successfully in a specific domain. Bandura posited that self-efficacy plays a critical role in determining how individuals approach challenges, persevere through difficulties, and ultimately achieve success. In the context of teaching, self-efficacy influences teachers' confidence, instructional choices, and ability to create effective learning environments (Tschannen-Moran & Hoy, 2001). This study, which assesses Junior High School (JHS) mathematics teachers' knowledge and confidence in teaching algebra in the Akwapim-North Municipality, is underpinned by Bandura's self-efficacy framework as it examines how teachers' perceptions of their abilities shape their instructional practices and challenges in algebra instruction.

Bandura (1997) identified four primary sources that shape self-efficacy beliefs: mastery experiences, vicarious experiences, verbal persuasion, and physiological and emotional states. These sources provide a lens through which the confidence levels of JHS mathematics teachers in teaching algebra can be analyzed.

Mastery Experiences: Teachers' past successes or failures in teaching algebra significantly impact their self-efficacy. Teachers who have had positive teaching experiences, such as successfully guiding students through algebraic concepts, are more likely to exhibit higher confidence levels. Conversely, repeated struggles in addressing students' misconceptions or in delivering effective algebra instruction can diminish self-efficacy (Gibson & Dembo, 1984). This study examines whether JHS mathematics teachers' years of experience influence their confidence in teaching algebra.

Vicarious Experiences: Observing other competent teachers effectively teach algebra can enhance self-efficacy, particularly for less experienced teachers. In schools where peer collaboration and professional learning communities are encouraged, teachers may gain confidence by learning from colleagues' successful strategies (Tschannen-Moran & Hoy, 2007). The study's exploration of pedagogical approaches used by JHS mathematics teachers provides insight into how collaborative learning and exposure to diverse teaching methods influence their self-efficacy.

Verbal Persuasion: Encouragement from colleagues, school administrators, and professional development programs can reinforce teachers' confidence in their ability to teach algebra. Studies have shown that teachers who receive constructive feedback and mentorship exhibit higher self-efficacy (Klassen et al., 2011). By investigating teachers' perceived challenges in teaching algebra, this study highlights whether the lack of professional training and instructional support affects their confidence.

Physiological and Emotional States: Teachers' emotional responses to algebra instruction, such as anxiety, stress, or enthusiasm—can influence their perceived competence. A teacher who experiences high stress due to difficulties in explaining algebraic concepts may develop lower self-efficacy (Bandura, 1997). The study examines whether JHS mathematics teachers face stress-related challenges, such as difficulty in translating algebraic word problems or the absence of adequate teaching resources, and how these factors shape their confidence levels.

Research has established a strong link between teachers' self-efficacy and their content knowledge (Shulman, 1986). Teachers with a firm grasp of algebraic concepts demonstrate greater confidence in their ability to teach the subject effectively. However, studies suggest that while high content knowledge is essential, it does not automatically translate into high self-efficacy—other factors such as pedagogical content knowledge and teaching experience play crucial roles (Depaepe et al., 2013). This study assesses the level of content knowledge among JHS mathematics teachers and investigates whether gaps in specialized content knowledge influence their self-efficacy in teaching algebra.

Teachers with high self-efficacy are more likely to adopt student-centered instructional strategies, such as inquiry-based learning, discussions, and real-world problem-solving approaches (Skaalvik & Skaalvik, 2010). Conversely, teachers with lower self-efficacy may rely on traditional, teacher-centered methods, such as rote memorization and direct instruction, which limit student engagement. This study explores the pedagogical approaches employed by JHS mathematics teachers in the Akwapim-North Municipality, identifying whether their self-efficacy influences their instructional choices.

The researcher chose this theory because it has a direct link with the current study's research objective three. This objective sought to find out the confidence level of JHS mathematics teachers in teaching algebra in the Akwapim-North Municipality.. According to Bandura (1997), self-efficacy influences how individuals approach challenges, persist in difficult situations, and perform in their professional roles. Teachers' confidence in teaching algebra is shaped by four key sources of self-efficacy: mastery experiences, vicarious experiences, verbal persuasion, and physiological/emotional states. Mastery experiences, which refer to past successes or failures in teaching algebra, play a crucial role in determining confidence levels, teachers who have effectively helped students understand algebraic concepts are more likely to develop high self-efficacy. Vicarious experiences, or learning by observing skilled colleagues, also influence confidence, as teachers who witness effective algebra instruction may adopt similar approaches and build their own teaching competence. Additionally, verbal persuasion, such as encouragement from administrators, colleagues, and students, reinforces teachers' belief in their abilities, further strengthening their confidence. Finally, physiological and emotional states, including stress or anxiety associated with teaching algebra, can impact self-efficacy, with teachers who experience frustration or resource limitations potentially exhibiting lower confidence. This study applies Bandura's theory to assess JHS mathematics teachers' confidence levels in teaching algebra, examining how their experiences, professional support, and emotional responses contribute to their self-efficacy.

2.2 Conceptual Review

2.2.1 Concept of Algebra

Algebra is a branch of mathematics that deals with the rules for operations, relationships between numbers, and various mathematical structures such as

polynomials, equations, and algebraic expressions (Julius et al., 2018). Kaput (2008) describes algebra as a body of knowledge that has become a key part of education and a cultural product. In traditional algebra, operations are performed on symbols following specific rules. School algebra is typically divided into three main strands: generalization, conversion, and transformational algebra. Algebraic thinking is a way of solving mathematics problems by focusing on general relationships between numbers.

Algebra is an important part of mathematics because it serves as a bridge from basic arithmetic in elementary school to more advanced mathematics in higher grades (Knuth et al., 2005). Blanton et al. (2015) describe algebra as a "mathematical language" that combines operations, variables, and numbers to clearly express mathematical structures and relationships (p. 67). Basic algebraic thinking involves key concepts such as variables, algebraic expressions, and equations. The concept of a variable is particularly important for developing algebraic thinking and making the shift from arithmetic to algebra (Blanton et al., 2017; Brizuela et al., 2015; Knuth et al., 2016). Understanding variables and equality is closely linked to how students learn to understand algebraic expressions and equations (Blanton et al., 2018; Kuchemann, 1978; Usiskin 1999; Weinberg et al., 2016).

Algebra allows us to use letters or symbols to represent numbers without specifying their exact values. In mathematical expressions, we use variables, coefficients, and constants. Common variables include letters like x, y, and z. A coefficient is a number that multiplies a variable, and a constant is a number that stands alone without a variable (Ali & Abatanie, 2023; Ali & Asemani, 2023; Ralston et al., 2018). For example, in the algebraic expression (3m - 7) = (6 + 9m), 'm' is the variable, '3' and '9' are coefficients, and '-7' and '6' are constants. To solve for the variable 'm',

one needs skills such as identifying and analyzing patterns, examining relationships, making generalizations, and interpreting changes. These skills are supported by a good understanding of numbers, operations, and relationships.

Algebraic involves ways of reasoning that help students prepare for more advanced mathematical concepts. It requires understanding mathematical symbols and tools to represent different types of mathematical information. These tools include words, diagrams, tables, graphs, equations, place value, proof testing, and searching for proofs. To develop algebraic thinking, students need to understand basic expressions, equations, patterns, and independent and dependent variables. Solving algebra problems often involves using both real-life situations and purely mathematical problems (Sibgatullin et al., 2022).

According to Baidoo and Ali (2023), algebraic problems can also appear as word problems. These are mathematics problems written in words that require algebraic equations or expressions to solve real-world situations. An algebraic word problem presents a scenario in words and asks a question, setting a goal for the solver to reach. To solve word problems, students need the persistence to work through algebraic expressions. Another important skill is learning how to identify and interpret keywords and phrases in mathematics problems. This involves teaching students to recognize the structure of a problem and translate the words into algebraic expressions or equations. For example, students might learn to recognize phrases like “is twice as many as” or “the sum of.”

2.2.2 Importance of Teaching Algebra in Schools

Algebra is an important part of the school curriculum in many countries. It makes up 30% of the mathematics test in the TIMSS (Trends in International

Mathematics and Science Study) exam, divided into two parts: expressions, operations, and equations (20%) and relationships and functions (10%). Algebra helps solve problems in the real world by teaching people to count, calculate, measure, organize, analyze, and relate different quantities and ideas (Agwagah, 2017).

Algebra is often called a "gatekeeper"in school mathematics because it opens the door to higher levels of education (Donovan et al., 2022). Many studies have emphasized the importance of algebraic thinking in mathematics and mathematics education (Cai & Moyer, 2008; Hodgen et al., 2018). Algebra is considered the foundation (National Mathematics Advisory Panel, 2008; Wilmot, 2008) and the language of mathematics.

The use of algebra in mathematics highlight its critical role in students' success and progress in mathematics (Star et al., 2015; Wilmot et al., 2018). This means that students with a weak foundation in algebra often struggle with mathematics in general. Therefore, it is crucial for students to build a strong foundation in algebra to excel and advance in mathematics (Makonye & Stepwell, 2016; Osei, 2020; Osei & Kubi, 2022).

Osei and Kubi (2022) state that algebra is so important in mathematics to the extent that it's nearly impossible for students to do well in mathematics without a strong foundation in algebra. This is because algebra is used in almost all other areas of mathematics (Wilmot et al., 2018). This suggests that students in primary and secondary schools need a solid understanding of algebra to improve their overall performance in mathematics as much of mathematics relies heavily on algebra.

2.2.3 Method of Teaching Algebra in Schools

Watkins (2018) emphasized that mathematics teachers must be equipped with various tools to foster students' conceptual understanding in algebra and to address any

misconceptions they might have. Essential tools include: (a) leveraging students' prior knowledge (e.g., Arcavi et al., 2017); (b) selecting diverse and rich examples, tasks, and questions (e.g., Leinhardt et al., 1990); (c) encouraging problem-solving activities (e.g., Star et al., 2015); (d) employing multiple representations (e.g., Goldin & Shteingold, 2001); (e) using manipulatives (e.g., Leitze & Kitt, 2000); and (f) incorporating technology (e.g., Yerushalmy & Chazan, 2008).

1. **Prior Knowledge**

Students bring pre-existing knowledge from both inside and outside the classroom. Research indicates that integrating this prior knowledge into lessons can enhance student achievement (Carpenter & Fennema, 1992). Teachers can connect algebraic concepts to real-world contexts or use engaging activities like games and puzzles to build on students' out-of-school experiences (Arcavi et al., 2017; Kalchman & Koedinger, 2005).

It is crucial for teachers to address students' misconceptions, as these can obstruct learning (National Research Council, 2001). For instance, if students exhibit errors such as the generalized distribution error, teachers should design instructional strategies to clarify these misunderstandings. An example might involve asking students to expand $(x + y)^2$ into $(x + y)(x + y)$ using the distributive property or to test whether the equation $(x+y)^2 = x^2+y^2$ is valid by substituting specific values for x and y.

2. **Use of Examples, Tasks, and Questions:**

When selecting examples, tasks, and questions for algebra instruction, teachers should take into account students' prior knowledge. It is beneficial for teachers to include both standard and nonstandard forms of algebraic expressions in their examples (Powell, 2015). For instance, when teaching quadratic equations, incorporating

examples in both standard form (i.e., $ax^2 + bx + c = 0$) and alternative forms can provide a more comprehensive understanding. Research also supports the use of solved problems during instruction, where teachers present problems with complete solutions and encourage students to analyze the steps and strategies used (Star et al., 2015). Additionally, presenting problems with intentional errors for students to identify can help them recognize and correct their own mistakes (Arcavi et al., 2017).

When developing or selecting tasks, teachers should choose those aligned with educational standards and characterized by multiple entry points, exploratory approaches, and the use of various representations. Tasks should be open-ended, allowing for multiple solutions, and should connect to students' prior knowledge to foster deep learning and problem-solving skills (Ronau et al., 2014). Teachers must also consider the types of questions they pose. Effective questions include reversibility questions, which ask students to create problems based on given solutions; flexibility questions, which encourage students to compare or solve problems in different ways; and generalization questions, which prompt students to find patterns or create examples of rules or patterns (Dougherty, 2001; Ronau et al., 2014). For example, reversibility questions might ask students to find equations of lines passing through a specific point, while flexibility questions might compare functions or solve problems using various methods.

3. Problem Solving:

Effective problem-solving instruction involves more than selecting appropriate tasks and questions; it requires incorporating these tasks meaningfully into classroom activities (Lester, 2013; NCTM, 2000). To enhance students' problem-solving abilities, teachers should develop and select tasks that are both meaningful and challenging. Teachers should engage with students' ideas during problem-solving processes, using

their contributions as a basis for further discussion. Asking probing questions to stimulate critical thinking, helping students apply effective problem-solving strategies, and encouraging productive struggle are all crucial components (Cai, 2010; DiMatteo & Lester, 2010; Lester, 2013). Productive struggle involves students working through non-routine problems and understanding the underlying mathematical concepts, requiring perseverance and multiple approaches to problem-solving (Herbst & Kosko, 2007). Teachers should allow students sufficient time to tackle problems and resist the urge to intervene prematurely, instead using probing questions to support and guide their learning (Warshauer, 2015).

4. **Multiple representations**

When planning lessons, teachers should include tasks that encourage students to use different forms of representation, such as graphs, tables, equations, and written descriptions (Ronau et al., 2014). Understanding mathematics deeply involves recognizing how these different forms represent the same idea and how they are structurally similar or different (Goldin & Shteingold, 2001). To help students make these connections, teachers can present multiple representations together in the same lesson (Kalchman & Koedinger, 2005), discuss what information each representation conveys (Star et al., 2015), and ask students to compare and interpret across representations (Oehrtman et al., 2008). For example, in a lesson about linear equations, students might explore the equation $y=3x-1y = 3x - 1y=3x-1$ along with its graph and table. They would examine how the equation shows the slope and y-intercept, the graph shows the x- and y-intercepts and overall behavior of the line, and the table illustrates the consistent relationship between x and y values.

5. **Manipulatives**

In addition to graphs, tables, manipulatives are another useful tool that can aid students in understanding algebraic concepts. Manipulatives can be either physical objects, like blocks or tiles, or digital tools, such as software applications. They share a common goal: to provide hands-on models of abstract ideas that students can interact with directly (Suh & Moyer, 2007).

Studies show that manipulatives can significantly boost student performance (Rakes, et al., 2010; Suh & Moyer, 2007). However, they are often not used enough in teaching, particularly in middle and high school math classes (Leitze & Kitt, 2000). Therefore, teachers should seek effective ways to integrate manipulatives into their lessons. Examples of manipulatives used in algebra instruction include balance scales and algebra tiles.

Balance Scales: These devices are designed to help students learn how to solve linear equations (Powell, 2015). Typically, balance scales have two pans one for each side of the equation and use blocks to represent different values: a unit block for 1 and a variable block for an unknown value, x. Some advanced balance scales might include additional features such as blocks for negative numbers or extra pans. Figure 4 provides an illustration of a traditional balance scale. Balance scales help students visually understand the process of solving equations. When the scale is balanced, it shows that both sides of the equation are equal. Students can perform arithmetic operations on both sides to maintain this balance. If the scale tilts, it indicates that the equation is not balanced, aiding students in understanding that both sides must be equal to find the value of x (Suh & Moyer, 2007).

Using balance scales has several benefits. They offer a visual and tangible way to approach solving linear equations (Vlassis, 2002) and help students grasp the concept

of equality in equations (Rojano & Martínez, 2009). In essence, balance scales illustrate that both sides of an equation must be equal, reinforcing fundamental algebraic concepts (Powell, 2015).

Figure 2.3: Example of a balance scale.

Algebra tiles are another valuable tool for teaching algebra. These tiles help students understand not only how to solve linear equations but also how to work with multiplying monomials and binomials, and factoring quadratic expressions (Leitze & Kitt, 2000). Typically, algebra tile sets include:

- Small squares (measuring 1 × 1) with an area of 1, representing the number 1.
- Rectangles (measuring 1 × x) with an area of x, representing the variable x.
- Large squares (measuring x × x) with an area of x^2, representing the squared term x^2.

The dimensions of the rectangles and squares are designed so that the length of the rectangle matches the side length of the small square, and the width matches the side length of the large square. Figure 5 illustrates a set of algebra tiles.

Using algebra tiles helps students grasp key algebraic concepts, including the nature of variables, properties of numbers, and geometric principles (Chappell &

Strutchens, 2001). Algebra tiles offer a blend of algebraic and geometric perspectives through an array-based multiplication model, similar to methods used in elementary education (Leitze & Kitt, 2000).

However, it is important for teachers to bridge the gap between the tangible experiences students have with manipulatives like algebra tiles and the abstract mathematical concepts they represent (Bohan & Shawaker, 1994). If students cannot see how these hands-on activities connect to the underlying math concepts, they may not fully benefit from using these tools.

6. Use of Technology

Using technology, such as virtual manipulatives and digital tools like spreadsheets, graphing calculators, and computer algebra systems (CAS), can significantly improve algebra teaching and learning when applied effectively (Rakes et al., 2010; Yerushalmy & Chazan, 2008). Spreadsheets and graphing software help students explore and understand the relationships between different quantities, while CAS can simplify complex algebraic operations, reducing the cognitive burden on students. These tools can also support learning by providing multiple ways to represent and understand algebraic concepts (Yerushalmy & Chazan, 2008).

Teachers and students have access to various technological resources, including graphing calculators, interactive whiteboards (IWBs), computers or laptops, tablets, and smartphones. These devices often connect to online tools like educational apps and video tutorials, which can further enhance the learning experience (Arcavi et al., 2017).

However, it is crucial for teachers to be intentional when integrating technology into their algebra lessons. They need to select tasks that specifically benefit from the use of digital tools to deepen students' understanding. Teachers should also guide students in recognizing and discussing the mathematical concepts revealed through the

use of these tools, ensuring that the underlying mathematics is made clear and explored (Arcavi et al., 2017).

2.2.4 Mathematics Teachers Knowledge for Teaching Algebra

Mathematics teacher knowledge has been a focal point of research over recent decades, given its significant impact on addressing student challenges in mathematics. Numerous studies (e.g., Baumert et al., 2010; Campbell et al., 2014; Mohr-Schroeder et al., 2017) have demonstrated a clear link between teacher knowledge and student achievement, emphasizing its crucial role in educational outcomes. As a result, enhancing teacher quality has become a major concern for policymakers and educators.

Elbaz (1983) highlighted teacher knowledge as a pivotal factor in understanding the role of teachers and improving educational practices. Research has consistently shown that there is a dynamic interaction between teacher knowledge and student performance in mathematics (Baumert et al., 2009). This ongoing debate among researchers, educators, and policymakers underscores the importance of professional development. Large-scale studies like TEDS-M and TIMMS have further emphasized the need for improved teacher knowledge to boost student performance in mathematics (Blömeke & Delaney, 2012; Schoenfeld, 2010).

Shulman (1987) outlined teachers' professional knowledge across seven domains: general pedagogical knowledge, content knowledge, pedagogical content knowledge, curricular knowledge, knowledge of educational contexts, knowledge of learners and their characteristics, and knowledge of educational values, purposes, and philosophical and historical foundations. More recently, research has concentrated on two primary categories of mathematics teachers' knowledge: subject matter knowledge and pedagogical content knowledge (Ball et al., 2008; Carrillo-Yañez et al., 2018; Shulman, 1986).

Studies have consistently highlighted the mathematics teacher as a crucial factor influencing student understanding during instruction (Baumert et al., 2010; Rowan et al., 1997). A teacher's depth of knowledge and their challenges with algebra can significantly impact student achievement in mathematics (Campbell et al., 2014; Mohr-Schroeder et al., 2017). Since teachers can only impart knowledge they themselves possess, difficulties in their own understanding can be transmitted to students (Baumert et al., 2010; Campbell et al., 2014). To build a solid foundation in algebra for students, teachers must be adept at identifying and addressing algebraic difficulties, which is challenging if they have their own struggles in these areas (Fumador & Agyei, 2018). Furthermore, teachers who face difficulties with algebra content may struggle to develop effective teaching strategies to overcome student challenges and improve overall mathematics achievement (Osei & Agyei, 2023).

2.2.5 Teachers' Content Knowledge for Teaching Algebra

Teachers play a pivotal role in fostering students' algebraic reasoning (Blanton & Kaput, 2011). Kaiser et al. (2017) highlighted that recent research has largely focused on the cognitive aspects of teacher professionalism, particularly through large-scale studies examining the knowledge of mathematics teachers (Blömeke et al., 2014; Bruckmaier et al., 2016). Content knowledge is essential for effective teaching, as it impacts how well teachers convey algebraic concepts. The debate over the necessary depth of teachers' knowledge has been ongoing in teacher education (Ball et al., 2008; Hill et al., 2007).

Shulman (1986) emphasized that teachers should not only grasp why a mathematical proposition works but also understand its integration with other areas of knowledge. Teachers should be capable of explaining the rationale behind a concept

and its relevance, rather than just presenting isolated facts. The National Mathematics Advisory Panel further asserts that teachers must possess a thorough and advanced understanding of the mathematical content they teach, extending beyond the level they are assigned to instruct (National Mathematics Advisory Panel, 2008).

Content knowledge (CK) encompasses teachers' understanding of the subject matter they are teaching, including both factual knowledge and conceptual frameworks (Shulman, 1986). This knowledge involves a deep comprehension of the fundamental facts, definitions, formulas, and procedures within a discipline, as well as the foundational concepts such as mathematical functions. Additionally, CK includes an awareness of how these elements are organized and interrelated, including the methods used to establish validity and truth in the discipline, such as reasoning and proof (Shulman, 1986).

A strong grasp of content knowledge allows teachers to connect mathematical concepts with other subject areas, challenge students with thought-provoking questions, and utilize various resources beyond standard textbooks (NCTM, 2000). Shulman (1986) described CK as the "amount or organization of knowledge per se in the mind of the teacher" (p. 9). Ball (1991) further elaborated on CK by distinguishing between "knowledge of mathematics," which includes specific topics, procedures, and their interconnections, and "knowledge about mathematics," which encompasses insights into the nature of mathematical knowledge, its origins, and how truth is determined within the discipline (p. 6).

Ball et al. (2008) identified three key components of mathematical content knowledge: common content knowledge (CCK), specialized content knowledge (SCK), and horizon content knowledge (HCK). CCK involves performing basic mathematical

operations and solving problems that are generally applicable across various fields. It is not unique to teaching but represents the standard mathematical knowledge and skills that one would expect from anyone engaging with mathematics. While similar to Shulman's concept of subject matter knowledge (SMK), CCK is not tailored specifically for teaching contexts.

In contrast, specialized content knowledge (SCK) is explicitly required for effective teaching. This includes a deeper understanding of mathematical concepts, such as the ability to explain why certain procedures work, like the process of inverting and multiplying fractions. SCK encompasses the use of mathematical language, the creation and use of mathematical representations, and the ability to articulate the reasoning behind mathematical procedures. Unlike CCK, which focuses on performing mathematical tasks, SCK involves a conceptual grasp of the underlying principles. The third component, horizon content knowledge (HCK), pertains to a teacher's understanding of the broader relationships between different mathematical topics. This knowledge allows teachers to help students connect new concepts with what they have already learned, facilitating a more integrated and comprehensive understanding of mathematics.

In Ghana, a study by Osei and Agyei (2024) investigated Junior High School mathematics teachers' algebra knowledge, both in-field and out-of-field, using the expanded KAT framework which includes domains such as SAK, AAK, ATK, PKSA, SATK, AATK, and PCKA. The findings indicated that SAK (Subject Area Knowledge) was the most prevalent knowledge domain among both groups of teachers. However, ATK (Algebraic Thinking Knowledge) and AAK (Algebraic Application Knowledge) were identified as the second most prominent domains for in-field and out-of-field

teachers, respectively. Overall, teachers' knowledge in these domains and their general algebra teaching knowledge were found to be below average.

Research highlights the impact of teachers' subject matter knowledge on their teaching practices (Copur-Gencturk, 2015; Hoover et al., 2016; McCrory et al., 2012; Spangenberg, 2021) and consequently on students' algebra learning outcomes (Huang & Kulm, 2012; Tchoshanow et al., 2017; Wasserman, 2015).

2.2.6 Teachers' Pedagogical Knowledge for Teaching Algebra

According to Shulman (1985), effective mathematics teaching demands a thorough and systematically organized body of knowledge. He introduced the concept of pedagogical content knowledge (PCK) as a specialized blend of content and pedagogical expertise that uniquely characterizes teachers' professional insight (Shulman, 1987). PCK represents the ability of educators to translate their understanding of algebra into teaching methods that are tailored to their students' developmental stages, abilities, and backgrounds. Magnusson et al. (1999) emphasized that PCK encompasses teachers' awareness of how students grasp specific subject matter, considering their interests and skills. Niess (2005) further defined PCK as the intersection where subject knowledge meets teaching and learning strategies (p. 510). Watkins (2018) suggested that PCK is the aspect of content knowledge that directly relates to pedagogical practices, involving the integration of content knowledge (CK) with general pedagogical knowledge (GPK). This includes the specific examples, tasks, representations, and strategies used by teachers to facilitate student learning, along with an understanding of students' preconceptions and conceptual challenges.

Various models of PCK are discussed in the literature (Aguilar-González et al., 2019; Ball et al., 2008; Magnusson et al., 2009; Shulman, 1987). Kind (2009) reviewed

these models and found common elements, such as the use of subject-specific representations, instructional strategies, and awareness of students' learning difficulties. Shulman (1986, 1987) described PCK as integrating two key dimensions: effective instructional strategies, which involve the use of relevant analogies, illustrations, examples, and explanations, and understanding students' specific learning challenges, including misconceptions and barriers from prior knowledge.

Ball et al. (2008) developed a model that identifies two primary aspects of teacher knowledge: Subject Matter Knowledge (SMK) and Pedagogical Content Knowledge (PCK). According to their framework, PCK is divided into three key components: Knowledge of Content and Students (KCS), Knowledge of Content and Teaching (KCT), and Knowledge of Curriculum. KCS involves understanding students' cognitive processes and learning challenges, such as recognizing which decimal concepts may be difficult for them. Hill et al. (2008) emphasized that KCS is fundamental to PCK as it focuses on the nuances of students' mathematical thinking. KCT pertains to the strategies and responses teachers use to address students' difficulties with mathematical concepts. The final component, Knowledge of Curriculum, refers to teachers' understanding of how to effectively present and sequence the content.

Research has explored the impact of teachers' knowledge of students' cognitive processes on algebra achievement (Baş et al., 2011; McCrory et al., 2012; Stephens, 2006; Şen-Zeytun et al., 2010; Tanışlı & Köse, 2013). Tanışlı and Köse (2013) argued that it is crucial for teachers to understand not just the specific misconceptions students may have, but also the underlying reasons for these misconceptions. This deeper insight allows teachers to anticipate and address operational misunderstandings, such as those related to the equal sign, based on their understanding of students' cognitive

experiences. Baş et al. (2011) investigated how well high school mathematics teachers grasp their students' algebraic thinking and how this understanding aligns with students' actual approaches. In their study, 49 ninth-grade students engaged in a pattern generalization task, and three teachers were interviewed about their expectations regarding students' algebraic strategies. The findings revealed a notable disparity between the teachers' predictions and the students' actual strategies. While two teachers anticipated that students would view variables as unknowns in problem-solving, the third teacher struggled to predict any strategies and erroneously thought students would use variables in a functional context. This discrepancy underscores the necessity for teachers to gain a better understanding of students' algebraic reasoning.

In another study, Tanışlı and Köse (2013) assessed the understanding of preservice middle school mathematics teachers (MSMTs) regarding students' algebraic thinking, difficulties, and misconceptions related to variables, equality, and equations. The study involved 130 fourth-year preservice MSMTs from two universities, using questionnaires and clinical interviews. The results indicated that preservice teachers frequently provided direct corrections to student errors rather than encouraging self-discovery of mistakes. For instance, when addressing a student's incorrect interpretation of "Ayse is 4 cm taller than Seda," many teachers opted for direct correction instead of fostering deeper reflection. Although 62% of preservice teachers could understand students' thinking, only 37% could explain the reasons behind students' errors, and 40% struggled to interpret misconceptions effectively. The study concluded that preservice teachers require enhanced training in algebraic concepts and diagnostic strategies to better address and resolve student misunderstandings.

A strong understanding of algebra among teachers positively impacts students' performance in mathematics (Wilmot, 2009; Yarkwah, 2017). Teachers' own

knowledge directly influences their ability to teach effectively, as they can only convey what they themselves understand. Therefore, it is crucial to regularly assess and improve the algebra teaching knowledge of basic school mathematics teachers to enhance students' grasp of algebra and, consequently, their overall mathematics performance (Osei & Kubi, 2022).

2.2.7 Teachers' Self-Confidence for Teaching Algebra

Teachers play a crucial role in shaping students' mathematical knowledge and performance. Their confidence in their teaching abilities, known as self-efficacy, can significantly impact their effectiveness and influence how students perceive their teaching and Pedagogical Content Knowledge (PCK). Research indicates that a teacher's belief in their own capabilities affects their instructional methods and can motivate or hinder students' achievement in mathematics.

The concept of self-efficacy, as defined by Bandura (1993), relates to an individual's belief in their ability to successfully perform tasks. For teachers, this belief impacts their motivation, approach to teaching, and classroom dynamics. It revolves around individuals' beliefs in their ability to perform specific tasks or achieve goals in the future. Unlike predictions about what someone will do, self-efficacy is concerned with what they believe they can accomplish under certain conditions (Maddux & Kleiman, 2016). Tschannen-Moran and Woolfolk Hoy (2001) highlight that teachers' self-efficacy influences their ability to engage and support all students, including those who may be unmotivated.

Self-efficacy is a concept defined by various scholars. Bandura (1994, p. 72) describes self-efficacy as "the belief in one's capabilities to organize and execute the courses of action required to achieve specific goals." It is often viewed as an individual's

self-assessment of their ability to plan and perform tasks to achieve optimal outcomes (Mookkiah & Prabu, 2019). These self-efficacy beliefs affect how individuals motivate themselves, behave, think, and feel. According to Bandura (1994), these effects are mediated through four primary processes: selection, affective, motivational, and cognitive.

Ozlu et al. (2013) further explain that self-efficacy refers to the confidence required to complete a task rather than simply believing in one's ability to perform it. High self-efficacy often leads individuals to view challenging tasks as opportunities rather than threats, thereby enhancing their performance and overall well-being (Olawale & Hendricks, 2022; Ozlu et al., 2013). Research indicates that teaching self-efficacy—defined as the beliefs teachers have about their ability to perform professional tasks—is a critical factor in shaping instructional strategies and influencing student achievement (Morris et al., 2017; Yurekli et al., 2020; Zee & Koomen, 2016).

Teacher efficacy refers to a teacher's confidence in their ability to enhance student learning, even under challenging conditions (Künsting, Neuber, & Lipowsky, 2016). High teacher efficacy is associated with better student learning and achievement (Katz & Stupel, 2016). This concept is crucial as a predictor of teaching performance, particularly in mathematics and education in general. Research shows a positive relationship between content knowledge and personal teaching efficacy (Newton, Leonard, Evans, & Eastburn, 2012), but no significant relationship is found between content knowledge and outcome expectancy.

Bandura identified four primary sources of self-efficacy. The first is mastery experiences, which involve past successes in similar tasks, reinforcing the belief, "I

succeeded before, so I can succeed again." These experiences are considered the most influential in shaping self-efficacy (Bandura, 1997). However, recognizing success can be difficult, particularly with complex tasks where it might not always be clear when one has succeeded (Palmer, 2011).

The second source is vicarious experiences. This involves observing others succeed in similar tasks, which can lead to the belief, "If they can do it, I can too." The third source, verbal persuasions, includes encouragement and positive feedback from others, reinforcing the idea, "They believe in me, so I can do it." Lastly, psychological and affective responses, such as stress and anxiety, also play a role in shaping self-efficacy.

Skaalvik and Skaalvik (2007) emphasize that it is not just the success itself but one's perception of success that provides efficacy information. This perception can be influenced by a combination of the sources mentioned above (Morris et al., 2023). Therefore, self-efficacy is not determined by each source acting independently but by the interplay of these various inputs.

Self-efficacy is closely linked to teaching effectiveness, including how teachers manage lessons and support student learning. Teachers with strong self-efficacy are generally more effective in using their PCK to help students overcome difficulties and achieve better outcomes (Bray-Clark & Bates, 2003). Those with high self-efficacy are more likely to engage in behaviors that promote student learning and motivation, resulting in improved academic performance (Barnes, 1998). High self-efficacy can also reduce mathematics anxiety and foster a positive learning environment, while low self-efficacy may undermine teaching effectiveness and student confidence (Beswick, 2006; Cakiroglu, 2008).

Effective use of technology and manipulatives in teaching can also enhance self-efficacy. For instance, digital tools and physical aids like balance scales and algebra tiles provide concrete models and visual representations that help students grasp complex concepts. However, it is essential for teachers to use these tools strategically to connect practical experiences with abstract mathematical ideas. Teachers' own experiences with mathematics, including their past learning experiences and beliefs about mathematics, also affect their teaching efficacy. Teachers with more experience tend to have higher self-efficacy and are more effective in their teaching (Takunyaci & Takunyaci, 2014). Strong self-efficacy is associated with better teaching practices and a more positive view of mathematics education (Briley, 2012).

Mathematics anxiety, which is the stress associated with mathematical problem-solving, can negatively impact both teachers' and students' self-efficacy. High levels of mathematics anxiety are linked to lower self-efficacy and can hinder effective teaching and learning (Ashcraft & Moore, 2009). Addressing mathematics anxiety through increased self-efficacy can improve problem-solving abilities and enhance overall teaching performance (Hoffman, 2010). In mathematics teacher education research, self-efficacy has been extensively studied, particularly concerning pre-service teachers (PSTs), and to a lesser extent, in-service teachers (ISTs). The concept of self-efficacy is often defined and measured differently depending on whether the participants are PSTs or ISTs.

For PSTs, research typically examines self-efficacy in several ways: regarding their own mathematics knowledge (e.g., Bjerke & Solomon, 2020; Norton, 2019), their ability to teach mathematics effectively (e.g., Giles et al., 2016), or as a combined measure of both mathematics knowledge and teaching ability (Bates et al., 2011; Briley, 2012). Additionally, self-efficacy in relation to actual mathematics knowledge is

frequently studied (Akay & Boz, 2010; Carney et al., 2016). Research consistently shows that self-efficacy in mathematics and mathematics teaching are closely linked, influencing mathematical competence, understanding of concepts, and procedural fluency (Bates et al., 2011; Briley, 2012).

In contrast, studies involving ISTs are less common. When they do occur, they generally focus on teachers' perceived effectiveness in teaching mathematics and managing classrooms (e.g., Charalambous & Philippou, 2010; Wilhelm & Berebitsky, 2019). Some studies do consider both subject knowledge and teaching effectiveness (Andrews & Xenofontos, 2015; Beswick et al., 2012; Xenofontos & Andrews, 2020). The scarcity of research on ISTs suggests an underlying assumption that experienced teachers generally possess high self-efficacy in mathematics, which may not always be accurate (Xenofontos & Andrews, 2020).

In algebra teaching, self-efficacy affects teachers. confidence in their algebra knowledge and teaching abilities impacts their effectiveness in instructing students and their understanding of algebraic concepts. Also, self-efficacy influences teachers perceived ability to teach algebra effectively and manage the classroom, with higher self-efficacy generally leading to better teaching and improved student outcomes. Overall, strong self-efficacy in teaching algebra supports more effective instruction and enhances student learning.

2.2.8 Challenges of Teaching Algebra

Algebra is often characterized as a difficult subject, both to learn and to teach (Stephens et al., 2004; Watson, 2017. It is seen as a fundamental element of mathematics education reform and is widely recognized as one of the most challenging topics in the mathematics curriculum, leading to numerous difficulties and

misconceptions for students (Blanton et al., 2015). Teachers also face distinct challenges in instructing algebra. Various studies (Chinnappan, 2010; Sultan & Artzt, 2011) have highlighted algebra as a specific area in mathematics that presents multiple challenges for educators. Pincheira and Alsina (2021) pointed out that research has revealed several gaps in mathematics teachers' knowledge of algebra.

These challenges include a lack of understanding of the different mathematical meanings of the equal sign, particularly its property of equivalence (Ferreira et al., 2017; Trivilin & Ribeiro, 2015), difficulties in managing algebraic tasks that involve using variables to represent unknown quantities (Bair & Rich, 2011), and problems with interpreting algebraic symbols, graphical representations, and solving algebraic problems (Strand & Mills, 2014). Additionally, teachers struggle with issues related to generalization and the use of symbolic language (Chick, 2009), deficiencies in fostering algebraic thinking that often result in solving algebra problems through trial and error (DiBernardo et al., 2017), and difficulties in handling tasks that require generalizations and connecting various representations (Noviyanti & Suryadi, 2019; Oliveira et al., 2021; Zapatera Llinares & Callejo de la Vega, 2018).

Wang and Hall (2018) conducted a comprehensive review of seventy-nine studies on attribution and found that teachers often attribute students' academic failures to personal factors related to the students themselves. However, some research indicates that teachers might also consider external and uncontrollable influences, such as the students' previous learning experiences or the teaching methods of former teachers (Bertrand & Marsh, 2015). For example, Carraher and Schliemann (2007) found in their research on early algebra that students' struggles are frequently due to the way arithmetic and basic math concepts are initially taught. These foundational gaps can lead to further difficulties when learning algebra. The presence of these teaching

challenges can make it harder for math teachers to support students who have difficulties with algebra (Kieran, 2018), reducing the effectiveness of interventions aimed at helping students overcome their algebra struggles.

Students themselves encounter a range of obstacles when learning algebra. A common challenge is understanding the different meanings of symbols, such as letters, variables, and constants, which are essential for developing algebraic thinking skills (Parrot & Leong, 2018). Sibgatullin et al. (2022) emphasize that teaching algebra successfully in schools requires teachers to be aware of their students' abilities to think algebraically, especially when solving mathematical problems. It is particularly important for high school teachers to grasp how their students approach algebraic reasoning. Children between the ages of 7 and 15 are typically in the formal operational stage of Piaget's developmental theory, a phase where they begin to develop more sophisticated reasoning skills necessary for understanding algebra.

When learning algebra, students frequently focus on memorizing solutions provided by teachers rather than developing actual problem-solving skills. As a result, when faced with algebraic problems that involve using variables to represent unknowns, students often find it challenging to understand equations that include both letters and numbers (Baidoo & Ali, 2023). Carraher and Schliemann (2007) argue that many of the difficulties students encounter in algebra stem from a limited understanding of the equal sign as an operator, an emphasis on specific quantities rather than generalized concepts, a lack of knowledge about fundamental properties of numbers and operations in arithmetic, and a poor grasp of variable notation to express relationships between quantities.

Ali and Adu-Poku (2021) suggest that students often get confused when translating algebraic expressions into word problems, converting word problems into linear equations and inequalities, and applying effective strategies to solve real-life problems (Ministry of Education, 2020). A significant factor contributing to these challenges is the delayed introduction to algebraic expressions in the curriculum. This delay hinders students' foundational understanding, which, in turn, impacts teachers' ability to incorporate problem-solving tasks into math lessons. This deficiency may affect students' ability to fluently apply algebraic concepts in real-world situations. To address this, it has been recommended that students need to develop a deeper understanding of mathematical concepts beyond the classroom, effectively bridging the gap between school and everyday mathematics (Adu et al., 2017).

The 2019 Trends in International Mathematics and Science Study (TIMSS) report noted that students often struggle with the language of mathematics. Additionally, examination reports from local municipalities indicate that many students are still performing below the national standards in mathematics and algebraic expressions (Mullis et al., 2020). Research by Asoma et al. (2022) highlights that poor language expression can significantly hinder problem-solving abilities. Students frequently have difficulty interpreting equations with both letters and numbers. Das (2019) observed that many students focus on applying straightforward arithmetic algorithms to get answers without fully considering the context of the word problems they are solving.

Booth (1988) suggested that students' challenges in algebra often stem from gaps in their arithmetic understanding. A key difficulty in algebra is grasping the concept of a variable, crucial for bridging arithmetic and algebra (Blanton et al., 2015). Many studies show students struggle to use variables to represent quantities and

relationships (McNeil et al., 2010; Stephens, 2005). Developing "symbol sense," or understanding the relational nature of algebraic symbols, is vital for algebraic proficiency (Jupri et al., 2020; Van Stiphout et al., 2013). Early education often limits the concept of variables to constants or unknowns, but a broader approach should include variables as changing quantities, generalized numbers, and parameters (Blanton et al., 2015; Lloyd et al., 2011).

Many students disengage from mathematics before reaching high school due to the challenges they face in learning algebra through traditional methods (Kaput, 2002). Kenney and Silver (1997) found that even twelfth-grade students struggled with basic algebraic tasks, such as solving simple equations, converting verbal descriptions to symbolic form, and articulating and defending their reasoning. These difficulties in learning algebra often lead to early dropout from mathematics courses in high school (Tiğli, 2023).

The Trends in International Mathematics and Science Study (TIMSS) includes questions that require students to apply algebraic models to real-world problems, interpret relationships, and perform algebraic procedures, like solving for one quantity given another in a formula. The study also includes problems involving linear equations and functions to assess how students understand changes in variables (Mullis et al., 2020). Although eighth-graders have shown gradual improvement in algebra performance over time (MoNE, 2014; MoNE, 2016; MoNE, 2020), their algebra scores in the TIMSS 2019 assessment remained below the average mathematics score (MoNE, 2020). These findings suggest that Turkish students in the eighth grade need additional support to enhance their algebra skills.

A study conducted by Osei and Agyei (2024) in Ghana examined the Knowledge of Algebra for Teaching among both in-field and out-of-field Junior High School mathematics teachers. The study identified eight significant difficulties that these teachers faced when dealing with algebra. Analyzing the teachers' written responses to algebra-related items on an achievement test, the study highlighted several key challenges. Firstly, the factorization of the difference of two squares was a notable difficulty among the teachers. Secondly, both groups of teachers struggled with correctly applying the distributive property, particularly when expanding brackets that contained multiple terms. Thirdly, expanding exponential expressions, especially those involving more than one term, posed a challenge for both categories of teachers. Fourthly, improper cancellation of factors was a recurring issue. Fifthly, the incorrect use of the equal sign in equations was another difficulty observed among the teachers. Sixthly, there was a noticeable misuse of the laws of indices. Seventhly, many teachers demonstrated errors in applying the correct order of operations. Lastly, both in-field and out-of-field teachers showed difficulty in translating word problems into equations.

These findings support previous research by Sultan and Artzt (2011), Chinnappan (2010), and Pincheira and Alsina (2021), which highlight algebra as a challenging area for mathematics teachers. Specifically, the difficulty teachers face with understanding and using the equal sign aligns with studies by Trivilin and Ribeiro (2015) and Ferreira et al. (2017), who found that teachers often struggle to grasp its different mathematical meanings, especially its equivalence property. Additionally, the difficulty with representing word problems algebraically, particularly using variables for unknowns, corresponds with Bair and Rich's (2011) observation that teachers struggle with tasks requiring variable representation. The challenges identified—such as expanding brackets with multiple terms, exponential expansions, canceling common

factors, applying laws of indices, and the order of operations—reinforce Strand and Mills' (2014) findings on the difficulties teachers face in solving algebraic tasks. These persistent challenges also hinder teachers' ability to effectively support students struggling with algebra, as noted by Bush and Karp (2013) and Kieran (2018).

These difficulties may account for the subpar performance of students in algebra. According to Osei and Kubi (2022), students in Ghana's basic schools have consistently shown weak proficiency in algebra-related questions on the Basic Education Certificate Examinations (BECE) over the years. This trend has been a significant factor in the overall poor performance of students in these exams for nearly a decade and supports the notion that students' struggles with algebra are especially concerning (Blume, 2000; RAND Mathematics Study Panel, 2003) and negatively impact their overall mathematics achievement (Willmot et al., 2018). The chief examiners' reports for mathematics in the BECE from 2011 to 2018 consistently pointed out several issues with students' algebra skills. These included difficulties in managing variables, particularly when more than one is involved, correctly removing brackets (especially those nested within each other or containing exponents), solving fraction problems, applying the BODMAS rule accurately, and simplifying algebraic expressions.

2.2.9 Influence of Mathematics Teacher Years of Experience on their Self-Confidence

The teaching experience of mathematics teachers, including their educational background and professional certifications, plays a crucial role in shaping their self-confidence. Teachers with advanced degrees or specialized certifications in mathematics tend to exhibit higher levels of confidence in their teaching abilities. These qualifications enhance their understanding of mathematical content and equip them

with effective instructional strategies, ultimately strengthening their self-confidence. Research has consistently shown that such credentials are positively correlated with teachers' confidence in handling complex mathematical topics and overcoming classroom challenges (Hill, 2018; Ma, 2010).

Beyond academic qualifications, years of teaching experience also significantly influence teachers' self-confidence. Generally, experienced teachers demonstrate greater confidence in managing diverse classroom dynamics and implementing effective teaching strategies. With time, they develop deeper content knowledge, refine their pedagogical approaches, and become more adept at identifying and addressing students' misconceptions. However, the impact of experience on self-confidence is not solely determined by the number of years spent in the classroom but is also shaped by the quality of teaching practices and access to continuous professional development. Teachers who engage in reflective practice and actively seek opportunities for improvement tend to exhibit higher self-confidence (Klassen et al., 2011).

Empirical studies have explored the relationship between teaching experience and self-confidence in mathematics instruction. For instance, Osei and Kubi (2022) examined the algebra knowledge of professional and non-professional basic school mathematics teachers in Ghana. Their study, framed within the Knowledge of Algebra for Teaching (KAT) framework, assessed teachers' school algebra knowledge, advanced algebra knowledge, and algebra teaching knowledge. Interestingly, the findings revealed that neither professional nor non-professional teachers showed significant improvement in their algebra teaching knowledge as their years of experience increased. This suggests that experience alone does not necessarily enhance

teachers' content knowledge in algebra unless it is supported by ongoing professional learning opportunities.

Similarly, Bjerke and Xenofontos (2024) conducted a cross-sectional study examining self-confidence changes among primary mathematics teachers at various career stages. The study included novice and experienced pre-service teachers (PSTs) as well as in-service teachers (ISTs). The findings confirmed that self-confidence in teaching mathematics generally increases with experience, reinforcing the idea that time spent in the profession contributes to teachers' confidence and instructional effectiveness. However, contrasting evidence was reported by Berg et al. (2024), who investigated the relationship between teachers' self-confidence in teaching mathematics (SETM), their instructional profiles, and pedagogical practices using data from 327 primary teachers in New Zealand. Their study found that experienced teachers had significantly higher SETM scores compared to their less experienced peers, highlighting the potential for increased confidence with years of practice.

These mixed findings suggest that while teaching experience can positively influence self-confidence, its impact is contingent on factors such as professional development opportunities, reflective practice, and the specific mathematical knowledge required for teaching. Several researchers (Brinkmann, 2019; Giles et al., 2016) have noted that self-confidence in teaching mathematics (SETM) primarily develops during the pre-service teacher (PST) training period. Additionally, other studies have identified variations in self-confidence during the early years of teaching (Hoy & Spero, 2005; Işıksal-Bostan, 2016; Thomson et al., 2022).

Professional development is another crucial factor influencing teachers' self-confidence. Continuous, high-quality professional development programs are essential

for enhancing teachers' confidence and instructional effectiveness. Programs that focus on both mathematical content and pedagogical strategies, and that offer practical applications and collaborative opportunities, tend to be particularly effective. These programs help teachers stay current with educational practices and enhance their confidence in teaching mathematics (Desimone, 2009; Garet et al., 2001). Effective professional development supports teachers in refining their skills and increasing their self-confidence.

Consequently, to maximize the benefits of experience, teachers should be encouraged to participate in continuous professional learning that enhances both their content knowledge and pedagogical skills.

2.3 Conceptual Framework

The conceptual framework for this study consists of several key variables extracted from the study on Junior High School Mathematics teachers' knowledge and confidence for teaching algebra in the Akwapim-North Municipality of Ghana. This framework, illustrated in Fig. 2.1, was crafted to align with the study's objectives and informed by existing literature. The framework highlights key variables of interest.

Dependent Variable (DV): According to Ledford et al. (2018), a dependent variable is the outcome or variable that researchers aim to explain or predict. It is influenced by changes in the independent variable(s). In this study, the dependent variable is the Knowledge of Teaching Algebra, which represents the level of understanding and capability a teacher demonstrates in effectively teaching algebra concepts to learners.

Independent Variables (IVs): Independent variables are factors or conditions that are manipulated or observed to determine their effect on the dependent variable

(Okoye & Hosseini, 2024). In this study, the independent variables include Content Knowledge (CK), which refers to the teacher's mastery of algebra content, including concepts, procedures, and problem-solving strategies, and Pedagogical Knowledge (PK), which refers to the teacher's understanding of effective teaching methods, instructional strategies, and classroom management techniques specific to teaching algebra.

Mediating Variables (MVs): Mediating variables explain how or why an independent variable influences a dependent variable, affecting the strength or direction of the relationship between them (McLeod, 2025). In this study, the mediating variables include teachers' confidence levels, which relate to their belief in their ability to teach algebra effectively and can influence how CK and PK translate into actual teaching performance, and Years of Teaching Experience, which refers to the length of time a teacher has been in the profession and may strengthen or weaken the relationship between CK/PK and algebra teaching knowledge.

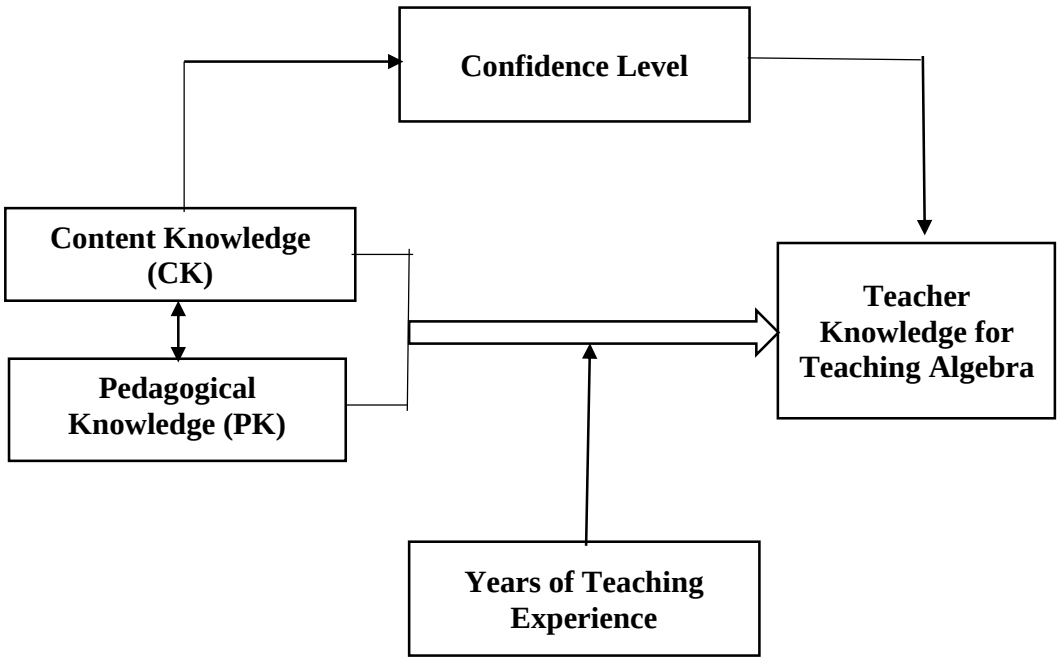

Figure 2.4: Researcher's Conceptual framework on Junior High School Mathematics teacher knowledge for teaching algebra in the Akwapim-North Municipality of Ghana.
(Source: Researcher's Own Construct, 2024).

From Figure 2.1, the arrows connecting Content Knowledge (CK) and Pedagogical Knowledge (PK) to the dependent variable (DV) illustrate the direct influence of these independent variables on teachers' knowledge of algebra instruction. The arrows linking the mediating variables indicate that self-confidence and years of teaching experience can modify or strengthen the effects of CK and PK on the overall knowledge of teachers for teaching algebra. CK and PK are expected to exert either a positive or negative impact on teachers' algebra teaching knowledge. In this model, self-confidence and teaching experience serve as mediators, suggesting that teachers with higher self-confidence or greater teaching experience are more likely to effectively apply their CK and PK in the classroom.

2.4 Empirical Review

2.4.1 Related Studies on Teachers' Self-Confidence

This section reviews empirical studies focused on mathematics teachers' self-confidence. It explores how various factors such as qualifications, professional development, and teaching experience influence teachers' confidence in their ability to effectively teach mathematics. For instance, Kumi (2023) explored the self-efficacy beliefs of Senior High School mathematics teachers in the Central Tongu District of the Volta Region, Ghana. Using a mixed-method research design, Kumi employed both a questionnaire and semi-structured interviews to gather data from 30 mathematics teachers and 30 students. The quantitative data were analyzed descriptively, while thematic analysis was applied to the interview data. The study found that teachers' self-efficacy beliefs were high, with a mean score of 4.57 (SD = 0.57). Despite this high

level of self-efficacy, there was no observed improvement in students' performance on final examinations. Kumi recommended further investigation into why high self-efficacy did not translate into better student outcomes.

Bjerke and Xenofontos (2024) conducted a cross-sectional study to trace changes in self-efficacy among primary mathematics teachers at various stages of their careers. The study included novice and experienced pre-service teachers (PSTs) and in-service teachers (ISTs). A validated 20-item instrument was used to measure self-efficacy, and Rasch analysis was performed to compare results among the four groups. The findings confirmed that self-efficacy in teaching mathematics increases with experience. The study highlighted the need for further research to understand how self-efficacy development can be supported during different career transitions.

Olawale and Hendricks (2024) investigated the impact of various factors such as gender, educational background, teaching phase, and school type on mathematics teachers' self-efficacy beliefs in the Eastern Cape Province, South Africa. Using a quantitative survey design, they sampled 266 teachers and analyzed the data with one-way ANOVA, independent samples t-test, and arithmetic mean. The study found that, despite teachers' high confidence in their instructional strategies, their self-efficacy was negatively affected by factors like school type and educational background. The authors recommended improving school environments and providing adequate instructional materials to support teaching and learning.

Berg et al. (2024) examined the relationship between teachers' self-efficacy in teaching mathematics (SETM), their teaching profiles, and pedagogical practices using data from 327 primary teachers in New Zealand. A multilevel structural equation model was employed to analyze the connections between SETM and effective pedagogical practices. The study revealed that experienced teachers had significantly higher SETM

scores compared to their less experienced peers. Teachers with high self-efficacy were more likely to implement effective pedagogical practices. No significant differences in SETM were found based on gender, year level, or school socioeconomic status, emphasizing the influence of teaching experience on self-efficacy.

From these, several gaps were identified. First, most of the studies, including those by Olawale and Hendricks (2024) and Bjerke and Xenofontos (2024), are conducted in regions outside Ghana, such as South Africa and New Zealand. They may not fully address the unique challenges and contexts of Ghanaian schools. Also, studies such as Kumi (2023) and Berg et al. (2024) broadly examine mathematics teachers' self-efficacy and pedagogical practices but do not specifically focus on algebra. These studies assess general mathematics teaching or self-efficacy across various subjects. There is a need for research specifically targeting algebra content knowledge, pedagogical knowledge, and self-efficacy among JHS mathematics teachers, particularly in the context of algebra. Similarly, studies such as that by Kusurkar et al. (2013) and Berg et al. (2024) explores the impact of qualifications and experience on general mathematics teaching but does not specify algebra teaching.

2.4.2 Related Studies on Teachers' Knowledge for Teaching Algebra

This section of the chapter examines empirical studies on teachers' knowledge for teaching algebra. In foreign context, studies focusing on teachers' knowledge of Algebra have also been conducted. Yildiz and Yetkin Özdemir (2021) conducted a study to examine the content knowledge of three middle school mathematics teachers during the introduction of basic algebra concepts, including variables, algebraic expressions, equality, and equations. The research focused on specific aspects of content knowledge, such as decomposing, trimming, and bridging concepts. Utilizing a case study design, data were collected through individual interviews and classroom

observations. The findings indicated that the teachers had limited conceptions of variables, algebraic expressions, and equations, which constrained their ability to effectively explain these concepts in the classroom. While the instructional practice of bridging was commonly observed, the quality of this bridging did not always result in a meaningful transition for students. On the other hand, the practice of trimming was rarely observed during instruction.

Watkins (2018) explored the Knowledge of Algebra for Teaching (KAT) in the USA by addressing three key research questions: the underlying factor structure of KAT as measured by an established instrument, the similarity in measurement of KAT constructs between pre-service and in-service teachers, and potential latent mean differences in KAT between these two groups. The study used multiple-group confirmatory factor analysis, a form of structural equation modeling, to analyze survey data from 1,248 participants gathered by KAT researchers at Michigan State University. The instrument used was designed to measure three types of algebra knowledge: knowledge of school algebra, knowledge of advanced mathematics, and mathematics-for-teaching knowledge. The results suggested that KAT might be a unidimensional construct since a one-factor KAT model fit the data better than a two- or three-factor model. Additionally, the study found that KAT was measured similarly across preservice and in-service teachers, with preservice teachers demonstrating slightly higher KAT. The findings highlighted the need for more professional development opportunities focusing on content knowledge (CK) and pedagogical content knowledge (PCK) for algebra teachers. The researcher concluded with recommendations for future research to further explore these areas.

Yılmaz and Erbaş (2017) investigated middle school mathematics teachers' knowledge for teaching algebra. The study involved 48 mathematics teachers from

various middle schools and employed a questionnaire to gather data on the teachers' knowledge related to algebra instruction. The results showed that the teachers were generally competent in making transitions among different algebraic representations. However, they faced challenges in explaining the conceptual bases of certain algebraic concepts and procedures. Furthermore, the study revealed that some teachers had difficulties and misconceptions similar to those of their students, as depicted in the scenarios provided in the questionnaire. These findings suggest a need for targeted professional development to address gaps in teachers' understanding and improve their ability to teach algebra effectively. None of these studies were conducted in Ghanaian contexts.

In Ghana, studies on teacher knowledge for teaching algebra are rather limited. They have primarily focused on senior high and tertiary teachers at the expense of JHS teachers. For example, Yarkwah (2017) conducted a study to assess SHS teachers' knowledge for teaching algebra

Donkor (2020) conducted a study to assess Senior High School (SHS) teachers' knowledge for teaching algebra. The study aimed to determine if the seven types of teacher knowledge hypothesized by the expanded Knowledge of Algebra for Teaching (KAT) framework would be supported. The research was conducted across 16 SHSs in the Eastern Region of Ghana and included final-year mathematics education students from a public university in the Central Region. A total of 278 participants, comprising all mathematics teachers from the SHSs and the final-year students, were involved in the study. Utilizing a cross-sectional survey design, the study employed a questionnaire based on the expanded KAT framework and performed confirmatory factor analysis on the data. The findings revealed that the seven types of teacher knowledge proposed by the framework were not supported; instead, only three types were identified. The study

also found that preservice teachers demonstrated higher algebra knowledge for teaching compared to in-service teachers, and mathematics teachers with professional qualifications were more proficient in teaching mathematics than those without professional qualifications.

Entsie (2021) evaluated the knowledge of pre-service teachers for teaching algebra, focusing on prospective senior high school mathematics teachers from teacher training universities in the Central Region of Ghana. The study aimed to identify the key factors that characterize pre-service teachers' knowledge for teaching algebra and their understanding of algebra itself. The research used a cross-sectional survey design and involved 164 pre-service mathematics teachers selected through a cluster sampling technique. The study applied the Expanded Knowledge of Algebra for Teaching framework and analyzed data using Principal Component Analysis and Parallel Analysis. The findings indicated that pre-service mathematics teachers' knowledge for teaching algebra is characterized by three factors: School Algebra Knowledge, School Algebra Teaching Knowledge, and Pedagogical Content Knowledge in teaching algebra. However, it was also revealed that pre-service teachers' overall knowledge of algebra for teaching is limited.

Osei and Kubi (2022) explored the algebra knowledge of professional and non-professional basic school mathematics teachers in Ghana. The study aimed to highlight their School Algebra Knowledge, Advanced Algebra Knowledge, and Algebra Teaching Knowledge, as hypothesized within the Knowledge of Algebra for Teaching (KAT) framework. Using a descriptive survey design, the study included 246 basic school mathematics teachers. The findings showed that both professional and non-professional teachers had similar levels of School Algebra Knowledge and Advanced Algebra Knowledge. However, professional teachers demonstrated higher overall

algebra teaching knowledge, which placed them ahead of their non-professional counterparts. The study also found that the algebra teaching knowledge of both professional and non-professional teachers did not improve with increased years of teaching experience. The researchers recommended in-service training for non-professional teachers to enhance their teaching knowledge and improve overall algebra teaching knowledge.

Osei and Agyei (2024) aimed to explore the algebra knowledge and challenges faced by Junior High School (JHS) students in both public and private schools in Ghana. The study used a descriptive survey design and included 441 students who completed an achievement test based on the learning behavior dimensions of the newly implemented standard-based mathematics curriculum. The results revealed a continuous decline in average scores and a decrease in the number of students performing at higher levels across the dimensions. Public school students demonstrated proficiency up to the Evaluating level, while private school students showed proficiency up to the Creating level, outperforming their public school peers in all six levels and in overall algebra knowledge. The study also identified ten significant algebra difficulties among JHS students, providing valuable insights into the depth of algebra knowledge and specific challenges faced by students in Ghana.

From the review, it was realized that most of the research, such as Yarkwah (2017), Donkor (2020), and Entsie (2021), focuses on Senior High School (SHS) and pre-service teachers rather than JHS teachers. These studies address algebra teaching knowledge at higher educational levels, leaving a gap in understanding JHS teachers' specific needs and competencies. Again, studies like Donkor (2020) and Osei and Kubi (2022) is conducted in various regions of Ghana but may not specifically address the context of the Akwapim-North Municipality. Also, studies such as Osei and Agyei

(2024) identify challenges faced by students rather than teachers. They provide insights into students' difficulties but do not focus on the specific challenges that JHS teachers face in teaching algebra. These gaps call for studies on JHS mathematics teachers' knowledge and self-efficacy in teaching algebra in the Akwapim-North Municipality, addressing content knowledge, pedagogical strategies, and specific challenges faced by teachers.

2.5 Summary of Literature Review

The literature review has meticulously synthesized evidence from various scholars, examining key aspects of teachers' self-efficacy and their knowledge for teaching algebra. The review has examined how theories such as Ball, Thames, and Phelps (2008) Model of Mathematical Knowledge for Teaching (MKT) and Ferrini-Mundy et al. (2005) Knowledge of Algebra for Teaching Framework serves as a suitable theoretical framework for the study on teachers' knowledge for teaching algebra.

Also, the review has illuminated key aspects of both content and pedagogical knowledge required for effective algebra instruction. It has demonstrated that a deep understanding of algebraic concepts is crucial for teachers to deliver accurate and meaningful instruction. This involves not only a strong grasp of algebraic principles and problem-solving strategies but also an ability to apply these concepts in diverse teaching scenarios.

Again, the review highlights the importance of pedagogical knowledge, which encompasses the strategies and methods teachers use to facilitate learning. Effective algebra teaching requires teachers to employ pedagogical techniques that make abstract algebraic ideas accessible and engaging for students. This includes the ability to design instructional activities, assess students' understanding, and adjust teaching methods based on students' needs and feedback.

Furthermore, the review highlights that self-confidence, a critical predictor of teaching effectiveness, is significantly influenced by teachers' qualifications, professional development, and teaching experience. Research indicates that teachers with advanced degrees and specialized certifications generally exhibit higher self-efficacy, which positively impacts their instructional practices and students' learning outcomes.

In the context of teaching algebra, the review identifies gaps in existing studies, particularly concerning Junior High School (JHS) teachers in Ghana. Most research has focused on senior high and tertiary education levels, leaving a need for more in-depth investigations into JHS teachers' content knowledge, pedagogical approaches, and self-confidence. The reviewed studies emphasize the need for further studies to address the identified gaps and enhance our understanding of how teacher knowledge and self-confidence influence algebra instruction among Junior High School Mathematics teachers in the Akwapim-North Municipality of Ghana.

CHAPTER THREE

METHODOLOGY

3.0 Overview

This chapter describes the methodology that was employed in examining Junior High School Mathematics teacher knowledge for teaching algebra in the Akwapim-North Municipality of Ghana. It provides details about the research paradigm, approach, design, study area, population, sample and sampling procedure, instrumentation, data collection, and analysis procedures as well as ethical considerations.

3.1 Research Paradigm

Every research endeavour requires a foundation, explicitly or implicitly found in the researcher's chosen worldview or philosophical framework as explained by Creswell and Plano-Clark (2018). According to Cohen et al. (2017) this framework serves as the philosophical or motivational foundation for undertaking a study. Hence, the nature of research is often influenced by a researcher's worldview. Additionally, Cohen et al argued that the research paradigm provides the philosophical motivation for conducting a study. Therefore, the approach adopted by a researcher is underpinned by the paradigm they subscribe to, based on the question they seek to answer. In line with this, study was aligned with the pragmatist research paradigm because the philosophy of pragmatism offers assumptions that underpin the incorporation of both quantitative and qualitative methods in mixed research approaches (Maarouf, 2019). Researchers can select the most appropriate methodology based on their specific context and the nature of their research question, thanks to pragmatism's adaptability. Pragmatism prioritizes practical problem-solving and outcome-oriented thinking, making it a fitting paradigm for studies in today's fast-paced world. The compatibility

between pragmatism and mixed methods research is one key reason for using pragmatism as a research paradigm (Kurniawati & Malasari, 2022).

The use of pragmatist research paradigm is well-aligned with the objectives of this study. First, Biesta (2020) argued that pragmatism emphasizes solving real-world issues through practical solutions. Hence, this study which aimed at improving algebra teaching in the Akwapim-North Municipality by examining teachers' knowledge and challenges, aligning with the pragmatic goal of achieving improved educational practices. Also, Johnson and Onwuegbuzie (2019) highlight that pragmatism allows for methodological pluralism, facilitating the integration of qualitative and quantitative data to provide a holistic view of a phenomena. As such, this study collected both quantitative and qualitative data to provide a holistic view of teachers' content knowledge, pedagogical approaches, self-confidence, and challenges in teaching algebra in the Akwapim-North Municipality.

3.2 Research Approach

This study adopted the mixed method research approach. This approach, according to Creswell and Creswell (2017) combines both quantitative and qualitative methods to gather and analyze data. It involves collecting and analyzing both numerical data (quantitative) and non-numerical data (qualitative) to gain a comprehensive understanding of a research problem or question. The mixed-methods approach recognizes that using multiple research methods can provide a more complete and robust understanding of complex phenomena. Dawadi et al. (2021) further elaborated that using the mixed methods allows researchers to complement and triangulate findings from different sources and perspectives, enhancing the overall validity and reliability of the study. They argued that the mixed-methods approach offers a flexible and comprehensive research strategy that allows researchers to explore complex

research questions, capture diverse perspectives, and generate more robust and nuanced findings.

The use of mixed method has several benefits. Manzoor (2020) was of the view that the strength of mixed-method approach lies in its methodological synergy that allows researchers to overcome each method's unique shortcomings, and makes the most of both quantitative and qualitative methods. By utilizing the other way to fill the gaps, it enables researchers to get beyond the flaws inherently present in each approach (Manzoor, 2020). On the shortcomings of this approach, Iaquinto (2016) warns that it can be methodologically and analytically challenging to combine quantitative and qualitative data, though. This is because it involves the combination and comparison of different data kinds, and this can be difficult to combine the results of various approaches into a comprehensible whole.

The mixed method approach was followed in this study for several reasons. The adoption of a mixed-method research approach in this study is justified by its ability to provide a comprehensive understanding of the research problem. By combining quantitative and qualitative methods, this approach enabled the collection of both numerical data, such as test and questionnaire responses, and non-numerical data, such as interviews, to capture the complexity of early teachers' knowledge and self-confidence for teaching algebra. The test allowed the researcher to measure teachers' knowledge for teaching algebra, while the use of self-confidence scale questionnaires was to quantify teachers' confidence in teaching algebra. Finally, the interview explored teachers pedagogical approaches and challenges in teaching algebra. This approach allows for triangulation of findings from multiple sources, enhancing the validity and reliability of the study. Creswell and Plano Clark (2018) emphasize the value of triangulation in mixed methods research. Additionally, the mixed-methods

approach offered the researcher flexibility in exploring diverse perspectives and generating nuanced insights into the research questions. Despite the challenges associated with integrating quantitative and qualitative data, such as methodological and analytical complexities, the methodological synergy of the mixed-methods approach enables researchers to overcome limitations inherent in individual methods and provides a deeper understanding of junior High School Mathematics teachers' knowledge for teaching algebra in the Akwapim-North Municipality. Tashakkori and Teddlie (2010) recommends for researchers to adopt mixed methods due to its flexibility in approach, and its ability to adapt methods to best address different aspects of the research questions of any study.

3.3 Research Design

Sequential Explanatory Mixed method design was adopted for this study. This design involves the collection of quantitative data via a written test and questionnaire, and is followed by interviews for collecting qualitative data (Creswell, 2014). The quantitative and qualitative data were analyzed to examine Junior High School Mathematics teacher knowledge for teaching algebra in the Akwapim-North Municipality of Ghana. The sequential explanatory design is employed when researchers seek to explore a research question or problem by first collecting and analyzing quantitative data, followed by collecting and analyzing qualitative data (Subedi, 2016). This design aims to provide a deeper, more nuanced understanding of the phenomenon under investigation by using the qualitative phase to explain, interpret, or elaborate on the quantitative findings. It allows researchers to bridge the gap between numerical data and the rich context and meaning behind those numbers.

Taguchi (2018) adds that using this design allows researchers to achieve a more comprehensive understanding of the research topic by combining quantitative data for

patterns and qualitative data for context and meaning. It provides a form of methodological triangulation, enhancing the validity and reliability of the research findings through the convergence of different data sources and methods. The sequential nature of the design allows researchers to refine and adapt their qualitative research questions based on the preliminary quantitative findings, ensuring that the qualitative phase addresses gaps or uncertainties.

However, Toyon (2021) warns researcher of the various disadvantages that comes with the use of this design**.** The author argued that the sequential explanatory design can be resource-intensive in terms of time, funding, and personnel, as it involves two distinct phases of data collection and analysis. Hence, managing and integrating quantitative and qualitative data can be complex, requiring a high level of expertise in both research paradigms. Also, Bowen et al. (2017) observed that in using this design, researchers' preconceived notions or biases from the quantitative phase may influence the design and execution of the qualitative phase, potentially affecting the validity of the qualitative findings.

Despite its challenges, this design was chosen over others by its ability to provide an in-depth understanding of the Junior High School Mathematics teacher knowledge for teaching algebra. By initially collecting and analyzing quantitative data, the researchers was able to establish patterns, trends, and associations related teachers' knowledge and self-confidence. Subsequently, the qualitative phase allowed the researcher to delve for a deeper exploration and interpretation of these quantitative findings, offering insights into the pedagogical approaches and challenges that comes with teaching algebra in their unique educational context. This sequential approach enables researchers to bridge the gap between numerical data and the rich qualitative

context, providing a holistic understanding of the Junior High School Mathematics teacher knowledge for teaching algebra in the Akwapim-North Municipality.

3.4 Study Area

The study was conducted in the Akwapim-North Municipality, a local government area in the Eastern Region of Ghana. The municipality was originally created in 1988 as the Akuapim North District and was later upgraded to municipal status in 2012 to enhance administrative efficiency and local development. The municipal capital is Akropong, which also serves as the traditional and administrative centre of the Akuapem area. Geographically, the municipality lies along the Akuapem ridge and shares boundaries with other districts in the Eastern Region, with road connections linking the area to major towns such as Koforidua and the national capital, Accra. According to the 2021 Population and Housing Census conducted by the Ghana Statistical Service, the municipality had a population of 105,315, comprising 49,546 males and 55,769 females. Population projections by the Akwapim-North Municipal Assembly estimated the population to increase to 112,687 in 2022 and 120,575 in 2023, reflecting steady demographic growth.

Economically, the municipality is largely agrarian, with most residents engaged in subsistence and small-scale farming. Common crops grown in the area include cassava, plantain, cocoyam, maize, and a variety of vegetables. In addition to farming, agro-processing activities such as gari processing and palm oil production provide employment for many households. Some residents also participate in trading, small-scale commerce, and other service-related activities in the local markets and towns. The municipality has a mix of rural and semi-urban communities, and basic social services such as schools, health centres, and markets support the livelihoods of the population.

The main languages spoken in the area are Twi and other Akan dialects, although English is widely used in formal education and administration.

For educational administration, the municipality is divided into nine circuits: Mangoase, Amanfrom, Adukrom, Akropong, Larteh, Mampong, Adawso, Tinkong, and Okorase. The municipality extends from Mampong-Akuapem through Akropong to Okorase near Koforidua and also stretches toward Nyamebekyere and surrounding communities. There are about 89 registered Junior High Schools within the municipality under the supervision of the local education directorate. The area was selected for this study due to the persistent poor performance of students in the Basic Education Certificate Examination (BECE) over several years (2009–2019). Furthermore, a study by Amoah et al. (2023) on students' and teachers' attitudes toward mathematics in the municipality revealed that many learners demonstrated low interest and weak performance in mathematics, particularly in problem-solving tasks. The municipality was also selected because the researcher had worked in the area for several years, which made it easier to access schools, interact with teachers and students, and collect reliable data within the required timeframe for the study.

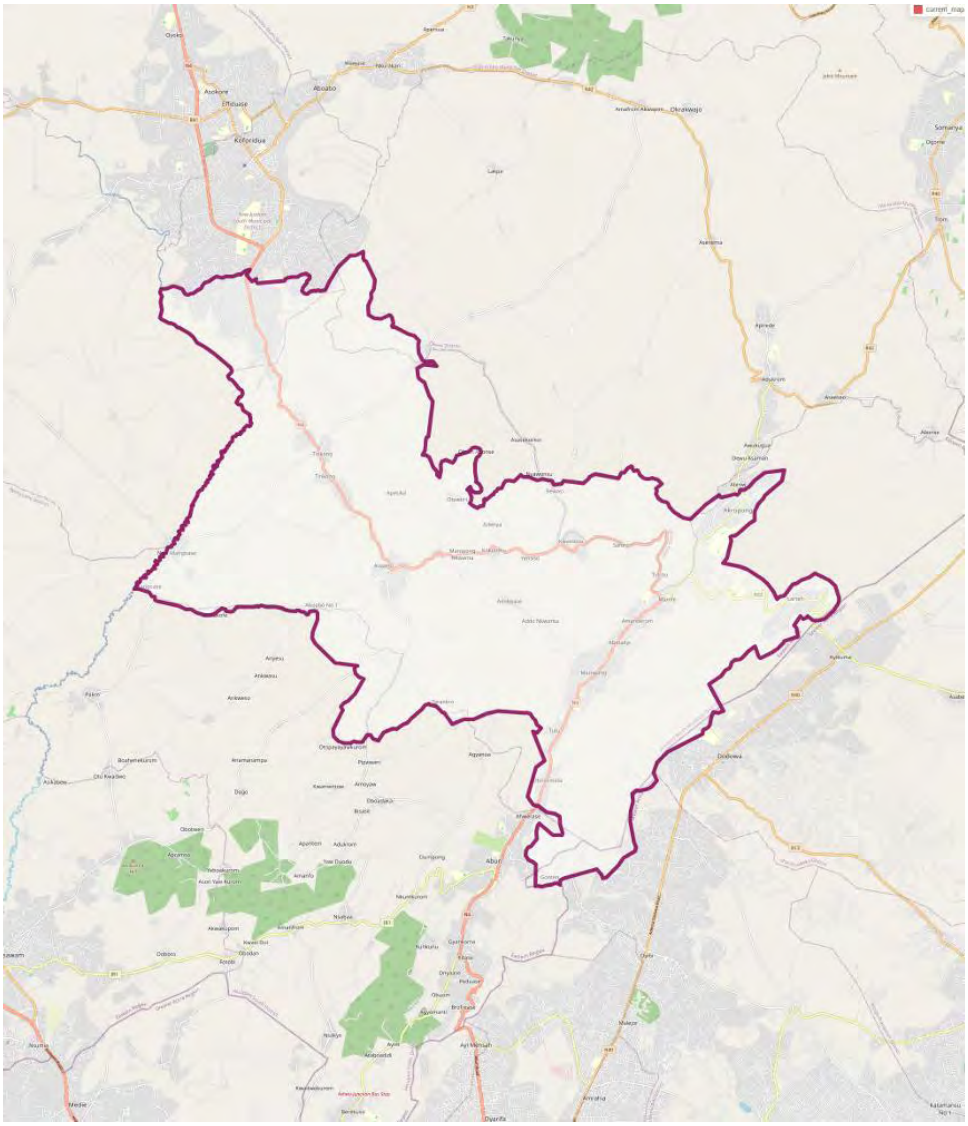

Fig. 3.1: Map of Akwapim-North Municipal Assembly

Source: Akwapim-North Municipal Assembly Website

3.5 Population

Obilor (2018) postulates that a population refers to any collection of specified groups of human beings or no human entities such as objects, educational Institutions, time, units and geographical area. It serves as the broader scope for researchers to generalize their findings, encompassing people, objects, events, or entities relevant to the research question. In this study, the population comprised all JHS Mathematics teachers in the Akwapim-North Municipality. According to data from the Municipal Education Directorate (2024), there were a total of eighty-three (83) JHS Mathematics

teachers in the Municipality, with sixty (60) in public JHS and twenty-three (23) in private JHS.

3.6 Sample and Sampling Procedure

A sample is defined as "a group of a relatively smaller number of people selected from a population for investigation purposes" (Alvi, 2016, p.34). Sampling, on the other hand, refers to a procedure employed to select a small group (the sample) with the prospect to discover the characteristics of a large group (Sharma, 2017). In the context of this study, the sample refers to the teachers from whom data were collected.

The study's sample consisted of eighty-three (83) JHS Mathematics teachers. All these teachers were used for the quantitative while the qualitative phase involved nine (9) teachers, one from each of the nine circuits in the Akwapim-North Municipality. The use of all JHS Mathematics teachers was due to the limited number of JHS Mathematics teachers within the Municipality. Furthermore, employing all teachers in the study was feasible due to the manageable number of cases within the limited time frame, ensuring coverage of the views and opinions of all JHS Mathematics teachers within the Municipality.

In selecting teachers to participate in the study, three sampling techniques were used: Census for the quantitative phase while purposive and convenience were used for the qualitative phase. During the quantitative phase, the census was used to include all to JHS Mathematics teachers for the test and questionnaire administration. The researcher used census sampling because the number of JHS Mathematics teachers within the Municipality was relatively small and collecting data from every teacher was not overly burdensome in terms of time and resources. Singh and Masuku (2014) argued that census is more effective when the population for a study is small. Again, using census frame, as highlighted by Etikan and Babatope (2019) allows every

member of the population with an equal opportunity to participate in the study. And this was necessary to make the study's findings reliable. Moreover, census sampling technique has a higher potential to yield representative results devoid of sampling bias.

During the qualitative phase, purposive sampling was used to select nine (9) JHS mathematics teachers. Purposive sampling is supported by Etikan et al. (2016), who emphasize its use in selecting participants with specific characteristics relevant to a study. This approach ensures that only individuals with the necessary expertise or experience are included. In this study, purposive sampling was employed to ensure that only teachers with at least six (6) years of experience were included in the study. This criterion was necessary because teachers who have taught for six or more years are more likely to have undergone training related to the New Curriculum introduced in Ghanaian schools. By selecting experienced teachers, the study aimed to capture insights from individuals who have had sufficient exposure to both traditional and contemporary pedagogical approaches in teaching algebra before and after the curriculum revision.

From the 42 teachers who met the experience requirement, the researcher purposively selected nine (9) teachers from schools that were in close proximity to the researcher, making data collection more efficient. Furthermore, only teachers in close by school who were willing to participate in the study were included. Creswell and Poth (2018) emphasize that participant willingness enhances the quality of qualitative research by ensuring authentic and detailed responses. The sample size used is presented in Table 3.1.

Table 3.1 summarizes how Junior High School mathematics teachers are distributed by school type and shows the sample sizes used in each phase of the study

Table 3.1: Distribution of JHS Mathematics Teachers Based on School Type

S/N	School Type	Number of JHS teachers	Sample for Quantitative	Sample for Qualitative
1	Private	23	23	2
2	Public	60	60	7
	Total	**83**	**83**	**9**

Source: Field work (2024)

Table 3.1 shows the distribution of Junior High School mathematics teachers by school type in Akwapim-North Municipality. Of the 83 teachers, 23 (27.7%) are in private schools and 60 (72.3%) are in public schools. The quantitative sample includes all 83 teachers (a census), while a smaller qualitative subsample of 9 teachers was selected (2 from private schools and 7 from public schools). The key takeaway: most JHS mathematics teachers in the municipality work in public schools, and the qualitative sample intentionally emphasizes public-sector perspectives.

3.7 Data collection instruments

The study employed three instruments for data collection: structured questionnaires, test and semi-structured interviews as the data collection instruments as follows:

3.7.1 Structured Questionnaire

The primary instrument used to collect data in the study was a structured questionnaire. Sidhu (as cited in Owusu & Asare-Danso, 2014) posited that a questionnaire is a form prepared and distributed to secure responses to certain questions. The choice of the questionnaire was based on the assertion of Cook et al (2017) that, they are particularly advantageous whenever the sample size is large enough to make it uneconomical for reasons of time or funds to observe or interview every subject. Again, Dampson and Mensah (2014) on their part suggested that, in order to gather information about respondents (students and teachers) opinion on how

far they agree or disagree on a statement given, questionnaire is the ideal instrument. Despite these strengths, the weaknesses are that the respondents may not complete the questionnaire resulting in low response rates (Cook, et al, 2017). In other cases, if respondents do not understand some questions, there is no opportunity for them to have the meaning clarified (Pallant, 2018). However, the limitations that came with the questionnaire were resolved as the researcher explained the purpose of the questionnaire clearly to the respondents.

The questionnaire, provided in Appendix A, included both close and open-ended question tailored to assess teachers' content knowledge, pedagogical approaches, self-confidence and the challenges they face in teaching algebra. Items measuring self-confidence were adapted from Bandura's self-efficacy instruments, while the items on challenges were self-developed based on findings from Osei and Agyei (2024) regarding teachers' knowledge for teaching algebra. The instrument comprised five sections, labeled A to E. Section A collected demographic information, including gender, age, educational qualification, and mathematics teaching experience. Sections B and C contained open-ended items: Section B was in two parts. The first part included three items examining teachers' content knowledge, and Section C included two items exploring their pedagogical approaches to teaching algebra. The second part included two subjective items on JHS teachers' pedagogical approaches in teaching Algebra. Section D focused on self-confidence, consisting of ten items in which teachers rated their confidence in teaching algebra on a 0–10 scale, with 0–4 indicating "Cannot Do at All," 5 indicating "Moderately Certain Can Do," and 6–10 indicating "Certain Can Do." Finally, Section E aimed to identify the challenges JHS mathematics teachers encounter in teaching algebra in the Akwapim-North Municipality. This section had ten

items rated on a 4-point Likert scale: Strongly Disagree (SD) = 1, Disagree (D) = 2, Agree (A) = 3, and Strongly Agree (SA) = 4.

3.7.2 Mathematics Teachers Knowledge for Teaching Test

Shulman (1987) emphasized the importance of teachers' content knowledge and pedagogical content knowledge, highlighting the need for assessments that cover a range of algebraic concepts and skills. Similarly, Ball, Thames, and Phelps (2008) discussed the significance of specialized content knowledge in teaching, suggesting that tests should include questions that require deep understanding and the ability to apply knowledge in teaching scenarios.

In line with these, test was employed to measured teachers' level of content and pedagogical content knowledge for teaching algebra. The test items were self-developed using the Ghanaian JHS Common core Mathematics curriculum in line with Ball et al (2008) categorization of Mathematics teacher's knowledge for teaching. Items on Common Content Knowledge and Challenges in teaching algebra were adopted from Osei and Agyei (2024). Similarly, item on teachers' confidence for teaching algebra were adapted from Bandura's (2006) Guide for constructing self-efficacy scales.

The instrument was organized into three parts. Part I of the instrument examined teachers content knowledge for teaching algebra. There were three aspects of this: Common content knowledge, specialized content knowledge and horizon content knowledge. Common content knowledge contained three items based on equations, expression and pattens in algebra. Specialized content knowledge and Horizon content knowledge consisted of two (2) items each. Each items had enough space for teachers to solve or write in their responses.

Part II of the test assessed teachers' self-confidence in teaching algebra. There were ten items grouped under 4 aspects of self-efficacy as: performance

accomplishment, vicarious experience, verbal persuasion, and physiological information. Teachers were required to rate their confident in various aspect of algebra by recording a number from 0 to 10 using a 10-point scale.

Lastly, Part III of the instrument aimed at finding out the challenges JHS mathematics teachers face in teaching algebra in the Akwapim-North Municipality. There were 10 items hinged on a 4-point Likert scale ranging from Strongly Disagree (SD) = 1, Disagree (D) = 2, Agree (A) = 3, and Strongly Agree (SA) = 4.

3.7.3 Semi-Structured Interview Guide

A semi-structured interview guide, found in Appendix B, was also employed in the study. According to Kalilo et al (2016), a semi-structured interview is neither completely fixed nor completely free, and they are arguably best understood as adaptable. In most cases, interviews begin with some sort of predetermined questioning plan, but they then transition into a more conversational format, in which the questions may be answered in a sequence that is more natural to the flow of the conversation. It is possible that it will begin with only a few clearly stated inquiries, but it will pursue any fascinating abilities that may emerge.

The interview guide consisted of two main sections. The first section introduced the interview to participants and sought their consent to participate. The second section was divided into four parts. Part 1 included four items exploring teachers' content knowledge. Part 2 contained three items examining teachers' pedagogical approaches in teaching algebra. Part 3 comprised two items focusing on teachers' self-confidence in teaching algebra, while Part 4 included two items addressing the challenges teachers face when teaching algebra to their learners.

The interviews were conducted face-to-face interviews and audio-recorded by the researcher. The aim of the interview was to delve deeper into various aspects of the

JHS Mathematics teacher knowledge for teaching algebra in the Akwapim-North Municipality. These interviews lasted between 10-15 minutes, and responses were audio recorded. According to Kusi (2012) using this instrument in collecting data enable researchers to increase the likelihood that all of the study questions are answered. In reporting the findings, the pseudonym MT (Mathematics Teacher) was used to identify participants, with serial numbers ranging from 1 to 9 corresponding to the order in which the teachers were interviewed.

3.8 Validity and Reliability of the Data Collection Instrument

3.8.1 Validity

Ensuring the validity of an instrument is essential to guarantee that the data collected in a study is accurate and trustworthy (Leedy & Ormrod, 2014). To achieve this, several steps were taken. Firstly, the content validity of the questionnaire was rigorously assessed. The researcher ensured that the questionnaire items were designed with meticulous attention to the key variables outlined in the research questions. After this, the questionnaire was given to colleague M. Phil students for peer judgment to evaluate the clarity of statements, appropriateness of language, and the precision of instructions. Feedback from these colleagues was actively incorporated, leading to refinements in certain items for enhanced clarity.

Secondly, the construct validity was meticulously examined by ensuring a correct and thorough definition of the construct, including its key elements (Cohen et al., 2018). By this, the researcher did an extensive literature review on algebra and further sought expert opinions from senior researchers in the field. The goal was to confirm that the construct was accurately and adequately defined in the instrument. Lastly, the instrument underwent scrutiny by the researcher's supervisor for expert judgment. This assessment focused on determining the extent to which the

questionnaire reflected the full scope and complexity of the variables being measured. The supervisor's approval was sought, adding a final layer of assurance to the instrument's validity.

By undertaking these steps, the researcher made sure that the instrument was subjected to a validation process that helped to reinforce the confidence in the accuracy and trustworthiness of the data it would generate.

3.8.2 Reliability

The concept of reliability pertains to the likelihood of obtaining consistent results when the instrument measures the same variables more than once or when multiple individuals measure the same variable, as suggested by Noble and Smith (2015). Yakubu (2015) further defined reliability as a "measure of consistency of research instruments to obtain the same result with the same measure" (p. 63). To ensure reliability, the reliability co-efficient value was computed after the pilot testing of the instrument. The pilot test was conducted using 15 JHS mathematics teachers in Okyere District to assess the reliability of the research instruments. This number of teachers represented 18% of the sample used in the actual study, which is appropriate based on the common rule of thumb stating that a sample size of 10 to 20% of the full-scale survey sample size, or at least 30 to 50 respondents, should be used for any pilot test. The Okyere District was used because it shared close borders with Akwapim-North Municipality. Therefore, it was deemed that they JHS teachers in this district shared similar characteristics with the target population. Therefore, the responses of these teachers who shared similar attributes as those in Effutu could be relied on.

The pilot test helped the researcher to modify the instruments before using them in the actual study. For instance, the first draft of the questionnaire consisted of questions that were not grouped based on research questions. However, after the pilot

test, the items were grouped under the various research questions to give teachers an overview of the construct the items sought to measure. Similarly, the initial draft of the questionnaire had 34 items, but after the pilot test, this was reduced to 27 items. This was due to the detection that some questions were did not give clear instruction as to what the teachers had to do. Additionally, the teachers complained that the items had no insufficient spaces to write in their responses space. Hence, the spaces were doubled on the final draft of the questionnaire. Regarding demographics, the teachers asked whether the researcher meant years of teaching experience or years of teaching mathematics; hence, this item was modified to "years of teaching mathematics at the JHS level." Subsequently, reliability was tested for each of the categories, using Cronbach's alpha (α).

Also, the initial draft of the semi-structured interview guide was presented without reference to research objectives. Therefore, the final draft was modified, and questions were aligned with the objectives set to guide the study. Also, after the pilot test, the researcher realized that some questions had the same meanings, as the teachers gave similar responses to different questions. Hence, similar questions were merged, and repeated ones were deleted. This helped to reduce the initial 10 items on the guide to 5 items as non-applicable items were eliminated.

The overall reliability coefficient of the various items on the instrument calculated and found to be high ($\alpha = .822$). This implied that the instrument was capable of generating reliable data and hence acceptable for use in the actual study.

3.8.3 Trustworthiness of the Instrument

Trustworthiness criteria are one-way researchers can convince themselves and readers that their study findings are worthy or attention (Nowell, Norris, White, & Moules, 2017). Trustworthiness criteria was established for the semi-structured

interview guide. The criteria established confirmability, dependability, transferability and credibility as follows:

1. **Confirmability**

In qualitative research, confirmability is a crucial criterion for establishing the trustworthiness of the study. It refers to the degree to which the researcher's biases are minimized and the findings accurately reflect the participants' perspectives and experiences (Creswell, 2013). In this study, confirmability was ensured by employing techniques to minimize researcher bias and ensure that the findings accurately reflected the perspectives and experiences of the participants. The researcher actively prevented personal knowledge, values, and conclusions from influencing the study's findings. Additionally, each phase of the data analysis process, including the conclusions derived, was meticulously documented, following the guidelines suggested by Charmaz and Henwood (2017). This approach ensured that the study's findings were based solely on the data collected and analyzed, enhancing the confirmability of the research.

2. **Dependability**

Dependability, according to Richards and Hemphill (2018), refers to the consistency and reliability of the research process, ensuring that the findings are replicable and trustworthy. To enhance the dependability of the study findings, the researcher prioritized consistency and traceability throughout the research process. Clear questions were asked during data collection to ensure uniformity and minimize bias. Objectivity was carefully controlled to maintain consistency in the research procedures. Moreover, an audit trail was maintained, documenting all research procedures and decisions made during the study. By adhering to these practices, the researcher aimed to establish dependability in the study's findings, ensuring that they were reliable and consistent.

3. Transferability

Transferability, as described by Nowell et al (2017), focuses on the extent to which the findings of a qualitative study can be applied or transferred to other contexts or settings. The study also considered transferability by focusing on the applicability of its findings to other contexts. Detailed descriptions of the research context and participants were provided to enable readers to assess the relevance of the findings to their own situations. By offering rich and comprehensive insights into the study's setting and participants, the researchers aimed to enhance the transferability of the findings, allowing for their potential application in diverse contexts beyond the immediate study area.

4. Credibility

Credibility refers to the degree of confidence in the truth of the findings and interpretations drawn from the data (Creswell and Poth, 2018). Rigor in the research process and the soundness of data interpretation were demonstrated through various techniques. Prolonged engagement with the participants, triangulation of data sources, and member checking were employed to strengthen the credibility of the study's findings. These practices helped validate the accuracy and validity of the interpretations drawn from the data, enhancing the overall credibility of the research.

3.9 Data Collection Procedures

Before commencing data collection, the researcher obtained an introductory letter from the Department of Basic Education, University of Education, Winneba (see Appendix A) to seek permission from the various schools, offices, and other relevant authorities. Subsequently, the researcher visited the various schools within the Akwapim-North Municipality and presented copies of the letter to the heads of the junior high schools. Upon receiving permission from the school heads, the researcher proceeded to administer the questionnaire to individual teachers. Prior to administering

the questionnaires, consent was obtained from the teachers, and the purpose of the study was explained by the researcher. The quantitative data collection phase spanned a period of two (2) weeks. To ensure a high return rate, the researcher ensured that questionnaires were distributed and retrieved on the same day.

After the quantitative data analysis, the researcher visited the schools again to conduct follow-up observations and semi-structured interviews to gain a deeper understanding of the their experiences with teaching algebra in the Akwapim-North Municipality.

Then after the administering the questionnaire, face-to-face interviews were conducted by the researcher to assess teachers' knowledge for teaching algebra together with its associated challenges. These interviews lasted between 10-15 minutes, and responses were audio recorded.

The overall data collection process proved successful. Out of the eighty-three (83) questionnaires that were distributed to all the JHS Mathematics teachers within the Akwapim-North Municipality, 83 were retrieved, representing a return rate of 100%. The return rate exceeded the recommended minimum threshold of 80% for survey research, as recommended by researchers.

3.10 Data Processing and Analysis

The research data collected were analyzed both qualitatively and quantitatively. The field data were collated, examined, and edited to address questions that were partially answered or not answered, the questionnaires were serially numbered to facilitate easy identification. This precaution was necessary to ensure quick detection of any errors that may have occurred in the tabulation of the data. After editing and coding, Statistical Product and Service Solution (SPSS) software was used to analyze the data.

Before performing the desired data analysis, the data were cleaned by running consistency checks on every variable. Modifications were made after verifying the questionnaires. The demographic variables from the questionnaire were analyzed using frequencies and percentages, based on the demographic characteristics of the respondents. The second section of the questionnaire was analyzed based on the research questions set for the study using descriptive statistics (frequencies, percentages, mean and standard deviations).

For the qualitative data (interviews), thematic analysis was used. Thematic analysis involved reading through the data set (such as transcripts from in-depth interviews, and identifying patterns in meaning across the data to derive themes. Numbers were assigned to the interviews to facilitate easy identification, ensuring effective presentation and analysis of the data. The researcher independently coded the transcripts, grouped the codes, and generated themes and sub-themes using the framework method for the analysis of qualitative data into the adopted models. The themes and sub-themes were cross-checked by the researcher's supervisor to ensure the faithful capture of the data.

3.11 Ethical Considerations

This research took into consideration several ethical issues. According to Kusi (2012), ethics in educational research pertains to how researchers conduct themselves, their practices, and the consequences on participants. Ethical issues considered in this study include permission to collect data, informed consent, confidentiality, and anonymity as follows:

Firstly, I obtained permission from the various heads of the Junior High Schools selected for the study before administering the instrument to the respondents. This was

done to adhere to ethical rules, as it is unethical to collect data from an organization or social groups without permission from the gatekeepers (Kusi, 2012, citing Creswell).

Additionally, the teachers were informed about the study's purpose, how it would be carried out, their expected role, the kind of data to be collected, and how it would be reported. This provided participants with the choice to decide whether or not to participate. Such information is crucial, as people decide to participate in a study based on the quality of information they receive (Kumar, 2011). Ensuring participants were equipped with necessary information was prudent to encourage their participation. Respondents' consent and permission were sought before administering the questionnaire to them

Also, Kothari (2015) suggested that research participants should always be protected from harm. In this study, participants were not subjected to any physical or mental discomfort. The researcher ensured that questionnaires were filled at the teachers' convenience. Similarly, the teachers gave their consent for them to be involved in the study, thereby reducing discomfort in their respective classrooms.

Lastly, the researcher ensured that information provided by the teachers was treated with care to prevent unauthorized access. The collected data was used only for the study's purpose. These ethical issues were protected by ensuring teachers did not provide their names and addresses on the questionnaire. Information about the school did not appear in the study report. Cohn, et al. as cited in Kusi (2012), explained that confidentiality means researchers will not publicly disclose information, even if they can identify participants.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.0 Overview

This chapter presents the results and discussion of the findings. The chapter is presented under three sub-sections. The first section presents the demographic characteristics of teachers. The second section is about the analysis of the data for each research question. In the analysis of the data, statistical tools including simple frequency tables, percentages, mean, standard deviation and ANOVA test were used. The final section of the chapter gives the discussion of results.

4.1 Demographic information of respondents

This section presents the results of the analysis of the demographic information collected from the respondents. The data included gender, age category, highest qualification, and the number of years spent in teaching Mathematics. Table 4.1 shows the data.

Table 4.1: Demographic information of Teachers

Variables	Category	Frequency	Percent (%)
Gender	Male	63	75.9
	Female	20	24.1
	Total	**83**	**100.0**
Age Category	Less than 30 years	34	41.0
	30-39 Years	21	25.3
	40-49 Years	14	16.9
	50 years and Above	14	16.9
	Total	**83**	**100.0**
Highest Academic Qualification	Diploma	28	33.7
	Bachelor's Degree	48	57.8
	Master's Degree	7	8.4
	Total	**83**	**100.0**
Years of Teaching Mathematics	Less than a year	0	0.0
	1-5 years	41	49.4
	6-10 years	21	25.3
	11-15 years	7	8.4
	16 years and above	14	16.9
	Total	**83**	**100.0**

Source: Field Data (2024)

The data presented in Table 4.1 gives a breakdown of the demographic characteristics of the JHS mathematics teachers in the Akwapim North Municipality. The data indicates a significant gender disparity, with 63 (75.9%) of the teachers being male and only 20 (24.1%) being female. This suggests a male-dominated teaching profession in mathematics at the JHS level in Akwapim North Municipality. In terms of age distribution, the majority 34 (41.0%) are below 30 years, followed by 21 (25.3%) aged 30-39 years, while 14 (16.9%) each fall within the 40-49 and 50+ age categories. This suggests a relatively young teaching workforce.

Regarding academic qualifications, 48 (57.8%) hold a Bachelor's Degree, 28 (33.7%) possess a Diploma, and only 7 (8.4%) have a Master's Degree, indicating room for further academic advancement. Teaching experience varies, with 41 (49.4%) having 1-5 years of experience, 21 (25.3%) with 6-10 years, 7 (8.4%) with 11-15 years, and 14 (16.9%) having taught for 16 years or more. Notably, no teacher has less than a year of experience. The findings calls for the need for targeted training and mentorship programs to support younger teachers in further academic and professional growth.

It is concluded that the demographic analysis of JHS mathematics teachers in Akwapim North Municipality highlights a predominantly male and relatively young teaching workforce, with most teachers holding a Bachelor's Degree and having between one and five years of experience. While the presence of experienced teachers is notable, the relatively low number of teachers with advanced degrees suggests the need for further academic and professional development.

4.2 Research Question 1: What is the level of content knowledge for teaching algebra among JHS mathematics teachers in the Akwapim-North Municipality?

This objective of this research question was to assess JHS mathematics teachers' level of content knowledge for teaching algebra in the Akwapim-North Municipality. Descriptive statistics, including frequency counts and percentages were applied for the data analysis. The analysis was done based on three sub-categories: Common Content Knowledge (CCK), Specialized Content Knowledge (SCK), and Horizon Content Knowledge (HCK). Within each of these sub-category, teachers' level of knowledge was rated as high, moderate, and low levels using percentage-based divisions. A low level represents up to 33% of the total score. A moderate score falls between 34% and 66% and a high-level score is above 67% of the total score based on Bloom's cutoff categories for the total knowledge and attitude scores.

4.2.1 Common Content Knowledge of Teachers

This section presents the results on teachers' level of CCK for teaching algebra in the Akwapim-North Municipality. For CCK, 0–2 (low), 3–4 (moderate), and 5–6 (high). The results are presented on Table 2.

Table 4.2 presents the distribution of teachers' scores on the Common Content Knowledge (CCK) assessment.

Table 4.2: Scores for Common Content Knowledge of Teachers

Range of Scores	Level of knowledge	Frequency	Percentage (%)	M	SD
0-2	Low CCK	0	0.0	5.33	1.19
3-4	Moderate CCK	21	25.3		
5-6	High CCK	62	74.7		
TOTAL		**83**	**100%**		

Source: Field data (2024)

Table 4.2 reveals that the majority of teachers, 62 (74.7%) demonstrated a high level of Common Content Knowledge (CCK) in algebra, scoring between 5 and 6. A smaller proportion 21 (25.3%) exhibited a moderate level of CCK, scoring between 3 and 4, while no teacher fell within the low CCK category (0–2). The mean score of 5.33 (SD = 1.19) further supports the finding that most teachers possess high common content knowledge in algebra.

It is concluded based on the data that the majority of the JHS mathematics teachers in the Akwapim-North Municipality (74.7%) possess a high level of common content knowledge for teaching Algebra.

4.2.2 Specialized Content Knowledge (SCK) of Teachers

This section presents the results on teachers' level Specialized Content Knowledge (SCK) for teaching algebra in the Akwapim-North Municipality. For SCK, 0–3 (low), 4–6 (moderate), and 7–8 (high). The results are presented on Table 4.3.

Table 3 summarizes teachers' Specialized Content Knowledge (SCK) scores grouped into low (0–3), moderate (4–5), and high (6–8) levels.

Table 4.3: Scores for Specialized Content Knowledge of Teachers

Range of Scores	Level of knowledge	Frequency	Percentage (%)	M	SD
0-3	Low SCK	48	57.8	3.41	1.62
4-5	Moderate SCK	14	16.9		
6-8	High SCK	21	25.3		
TOTAL		**83**	**100%**		

Source: Field data (2024)

Table 4.3 reveals that the majority of teachers, 48 (57.8%), demonstrated a low level of Specialized Content Knowledge (SCK) in algebra, scoring between 0 and 3. A smaller proportion, 14 (16.9%), exhibited a moderate level of SCK, scoring between 4

and 6, while 21 (25.3%) achieved a high level of SCK, scoring between 7 and 8. The mean score of 3.41 (SD = 1.62) further indicates that most teachers have limited specialized content knowledge in algebra.

The conclusion drawn based on the data is that the majority of JHS mathematics teachers in the Akwapim-North Municipality (57.8%) have a low level of specialized content knowledge for teaching algebra.

4.2.3 Horizon Content Knowledge (HCK) of Teachers

This last section presents the results on teachers' level of Horizon Content Knowledge (HCK) for teaching algebra in the Akwapim-North Municipality. For HCK, 0–2 (low), 3 (moderate), and 4–5 (high). The results are presented on Table 4.4.

Table 4 presents the distribution of teachers' Horizon Content Knowledge (HCK) scores across three levels: low (0–2), moderate (3), and high (4–5)

Table 4.4: Scores for Horizon Content Knowledge of Teachers

Range of Scores	Level of knowledge	Frequency	Percentage (%)	M	SD
0-2	Low HCK	7	8.4	4.01	0.81
3	Moderate HCK	6	7.3		
4-5	High HCK	70	84.3		
TOTAL		**83**	**100%**		

Source: Field data (2024)

Table 4.4 indicates that the majority of teachers, 70 (84.3%), demonstrated a high level of Horizon Content Knowledge (HCK) in algebra, scoring between 4 and 5. A smaller proportion, 6 (7.3%), exhibited a moderate level of HCK, scoring 3, while only 7 (8.4%) had a low level of HCK, scoring between 0 and 2. The mean score of 4.01 (SD = 0.81) further supports the finding that most teachers possess a strong understanding of how algebra connects to broader mathematical concepts.

It is concluded based on the data that the majority of JHS mathematics teachers in the Akwapim-North Municipality (84.3%) have a high level of horizon content knowledge for teaching algebra. This means the teachers possess a high ability to relate algebraic concepts to other areas of mathematics and support students' deeper understanding.

4.2.4 Teachers' Overall Level of Content Knowledge (CK)

This section presents the overall results on Content Knowledge (CK) for teaching algebra in the Akwapim-North Municipality. The overall level was calculated by summing up the levels from all three sub-categories of content knowledge. The overall CK scores are categorized as follows: 0–6 (low content knowledge), 7–13 (moderate content knowledge), and 14–19 (high content knowledge). The results are presented on Table 4.5. Table 4.5 summarizes teachers' overall content-knowledge scores, grouped into low (0–6), moderate (7–13), and high (14–19) levels

Table 4.5: Overall Scores for Content Knowledge Teachers

Range of Scores	Overall Level of Content Knowledge	Frequency	Percentage (%)	M	SD
0-6	Low	0	0.0	13.05	3.35
7-13	Moderate	48	57.8		
14-19	High	35	42.2		
TOTAL		**83**	**100%**		

Source: Field data (2024)

Table 4.5 shows that the majority of teachers, 48 (57.8%), demonstrated a moderate overall level of Content Knowledge (CK) for teaching algebra, scoring between 7 and 13. A smaller proportion, 35 (42.2%), exhibited a high level of CK, scoring between 14 and 19, while no teacher fell within the low CK category (0–6). The

mean score of 13.05 (SD = 3.35) further supports the finding that most teachers possess a moderate understanding of algebraic content knowledge.

It is concluded based on the data for research question one that the majority of JHS mathematics teachers (57.8%) in the Akwapim-North Municipality have a moderate level of content knowledge for teaching algebra.

Based on the interview data, teachers reported feeling confident teaching topics such as Pattern and Relationships, Algebraic Expressions, Variables, and Linear Equations, often drawing on real-life examples like money, food, or everyday activities to help students understand concepts. Conversely, they indicated that they struggle most with Quadratic Equations, Simultaneous Equations, Word Problems, and Inequalities, as these topics require multi-step reasoning and the ability to translate problems from words into algebraic symbols, which students often find challenging.

Theme 1: Algebra Topics Teachers Are Comfortable With

Sub-theme 1: Pattern and Relationships

7 out of the 9 teachers mentioned that teaching patterns and relationships is one of their strong areas in mathematics. In the interview, one teacher said:

> *"I can easily teach patterns because students see the relationships and can predict what comes next." (MT 3, Female, 7 yrs experience)*

Another teacher shared:

> "*Patterns are simple to explain; most of my students quickly understand the rules behind the sequence*." *(MT 5, Male, 12 yrs experience)*

Lastly, a teacher added:

> "*Teaching patterns helps students develop logical thinking, and I enjoy showing them how to spot the sequence in real-life examples, like days of the week or money calculations*." *(MT 1, Male, 10 yrs experience)*

Sub-theme 2: Algebraic Expressions

6 out of the 9 teachers reported confidence in teaching algebraic expressions. One teacher noted:

> "*I can teach simplifying and expanding expressions well because I practice the examples before class*." *(MT 6, Male, 10 yrs experience)*

Another shared:

> "*Factorization is not difficult for me; I have different ways of explaining it so students can follow*." *(MT 2, Male, 15 yrs experience)*

A third teacher said:

> "*Algebraic expressions are easy for me, and I often use local examples, like calculating prices, to make students understand better*." *(MT 9, Male, 8 yrs experience)*

Sub-theme 3: Variables and Equations

8 out of the 9 teachers felt confident teaching variables and equations.

A teacher explained:

> "*I enjoy teaching equations because students can relate them to real-life situations like budgeting or dividing money among friends*." *(MT 5, Male, 12 yrs experience)*

Another teacher added:

> "*Introducing variables is simple when I use everyday examples, like counting yam portions or kola nuts*." *(MT 2, Male, 15 yrs experience)*

A third teacher mentioned:

> "*Equations are easy to handle because students understand that what you do on one side must be done on the other side as well*." *(MT 8, Female, 7 yrs experience)*

Sub-theme 4: Solving Linear Equations

7 out of the 9 teachers mentioned that solving linear equations is a strong area for them.

One teacher said:

> "*Solving linear equations is straightforward and students quickly follow the steps*." *(MT 4, Male, 8 yrs experience)*

Another teacher shared:

> "*I like teaching linear equations on the board because students understand the process easily*." *(MT 7, Male, 12 yrs experience)*

Lastly, a teacher added:

> "*Linear equations are predictable, and I often relate them to money problems or sharing items in class, which helps students follow well." (MT 3, Female, 7 yrs experience)*

Findings from the interviews show that most Junior High School mathematics teachers in the Akwapim-North Municipality feel comfortable teaching core algebra topics. A majority of the teachers indicated confidence in teaching patterns and relationships, variables and equations, and solving linear equations, while slightly fewer expressed the same level of confidence in algebraic expressions. Their responses suggest that this confidence is largely grounded in the procedural nature of these topics and their ability to connect concepts to familiar everyday situations. Teachers frequently mentioned that patterns are easy for students to grasp because they allow learners to observe and predict relationships. In the same way, algebraic expressions were described as manageable because teachers often prepare examples ahead of lessons and use multiple explanations to aid understanding. Confidence in teaching variables and equations was commonly linked to the use of real-life contexts such as sharing money or counting items, which teachers believe helps students make sense of abstract symbols. Similarly, solving linear equations was viewed as straightforward since students can follow clear steps and relate problems to practical situations. Taken together, these views suggest that teachers are most at ease with algebra topics that are

predictable and that lend themselves to step by step procedures and contextual examples drawn from daily life..

Theme 2: Algebra Topics Teachers Struggle With

Sub-theme 1: Quadratic Equations

5 out of the 9 teachers reported that teaching quadratic equations is challenging.

One teacher said:

> "*I find quadratic equations difficult because students often get confused when using the formula or factorization*." *(MT 5, Male, 12 yrs experience)*

Another teacher added:

> "*Teaching quadratics is tricky; some students struggle with negative numbers and finding the roots correctly*." *(MT 1, Male, 10 yrs experience)*

A third teacher shared:

> "*I feel less confident with quadratics because it takes longer for students to understand the steps, especially when solving word problems*." *(MT 3, Female, 7 yrs experience)*

Sub-theme 2: Simultaneous Equations

4 out of the 9 teachers indicated difficulty with simultaneous equations.

One teacher noted:

> "*Students often get confused when we solve two equations together, so I also struggle to explain clearly*." *(MT 2, Male, 15 yrs experience)*

Another teacher said:

> "*It's challenging to teach substitution and elimination methods because students sometimes mix up the steps*." *(MT 9, Male, 8 yrs experience)*

A third teacher mentioned:

> "*Simultaneous equations take more time to teach; some students make mistakes with the variables, which can be frustrating*." *(MT 7, Male, 12 yrs experience)*

Sub-theme 3: Word Problems in Algebra

8 out of the 9 teachers reported that word problems are difficult for them to teach. One teacher explained:

> "*Applying algebra to real-life problems is challenging because students cannot always change the words into equations*." *(MT 2, Male, 15 yrs experience)*

Another teacher shared:

> "*Students find it hard to understand what the problem is asking, so teaching word problems is not easy*." *(MT 4, Male, 8 yrs experience)*

A third teacher added:

> "*I try to relate problems to things they know, like buying food or selling goods, but some still struggle to follow*." *(MT 5, Male, 12 yrs experience)*

Sub-theme 4: Inequalities and Graphs

5 out of the 9 teachers indicated challenges with inequalities and graphs.

One teacher said:

> "*Inequalities are tricky, especially when showing them on the number line*." *(MT 3, Female, 7 yrs experience)*

Another teacher added:

> "*Some students do not understand the signs for greater than or less than, which makes teaching graphs difficult*." *(MT 8, Female, 7 yrs experience)*

A third teacher mentioned:

> "*Graphing inequalities takes more time in class, and I have to explain it slowly to make students follow" (MT 6, Male, 10 yrs experience)*

Findings from the interviews also reveal that some algebra topics present noticeable challenges for Junior High School mathematics teachers in the Akwapim-North Municipality. About half of the teachers reported difficulty teaching quadratic equations, explaining that students often struggle with applying formulas, handling

negative numbers, and identifying roots accurately. These challenges appear to affect teachers' own confidence, especially when lessons require extended time and deeper explanation. Simultaneous equations were also identified as problematic by several teachers, particularly when using substitution and elimination methods. Teachers noted that students frequently mix up steps or make errors with variables, which makes instruction demanding and sometimes frustrating.

Word problems in algebra emerged as the most challenging area, with nearly all teachers indicating difficulty in helping students translate verbal statements into mathematical expressions. Teachers explained that learners often fail to understand what the problem is asking, even when familiar real-life contexts are used. This suggests that moving from everyday language to symbolic representation remains a major instructional hurdle. In addition, inequalities and their graphical representations were reported as challenging by several teachers. Difficulties arise when students struggle to interpret inequality signs or to represent solutions correctly on number lines and graphs. Teachers noted that these topics often require slower pacing and repeated explanation to support student understanding. Overall, the findings indicate that teachers experience greater difficulty with algebra topics that demand multi-step reasoning, interpretation, and the translation of concepts into symbolic or graphical forms.

4.3 Research Question 2: What pedagogical approaches do JHS mathematics teachers employ in teaching algebra in the Akwapim-North Municipality?

The second objective was to explore JHS mathematics teachers' pedagogical approaches in teaching algebra in the Akwapim-North Municipality. The aim was to find out the instructional techniques and resources utilized by the teachers in teaching

algebra. The open-ended data from the questionnaire were analysed using percentages and frequency while the interview data were thematically analysed.

Table 4.6 outlines the pedagogical approaches JHS mathematics teachers use when teaching algebra. It reports how many teachers agreed they use each approach and the corresponding percentages

Table 4.6: Teachers' Pedagogical approaches in teaching algebra

Approaches in teaching algebra	N	Frequency (Agree/Usage)	Percentage (%)
Use of verbal explanation	83	78	93.9%
Use of real-life examples	83	34	40.9%
Use of group work	83	81	97.6%
Use of problem solving	83	25	30.1%
Use of Physical Manipulatives	83	21	25.3%
Use of Visual Aids	83	42	50.6%
Use of class discussion	83	71	85.5%
Use of demonstration	83	56	67.4%
Use of digital tools/algebra software	83	23	27.7%

Source: Field Data (2024)

Based on Table 4.6, the analysis of teachers' pedagogical approaches in teaching algebra reveals that the most commonly used approaches are group work (97.6%), verbal explanation (93.9%), and class discussion (85.5%), indicating that teachers heavily rely on interactive and collaborative methods to facilitate understanding. Demonstration is also frequently used (67.4%), showing that teachers often model algebraic procedures before students attempt them.

Moderately used approaches include visual aids (50.6%) and real-life examples (40.9%), which suggest that while some teachers integrate contextual or visual support, it is not yet widespread. The least utilized approaches are problem solving (30.1%),

digital tools/algebra software (27.7%), and physical manipulatives (25.3%), indicating limited use of hands-on, exploratory, or technology-based strategies in teaching algebra.

The survey data suggest that in teaching algebra, teachers mostly used group work (97.6%), followed by verbal explanation (93.9%), class discussion (85.5%), demonstration (67.4%), visual aids (50.6%), real-life examples (40.9%), digital tools (27.7%), problem solving (30.1%), and least of all physical manipulatives (25.3%).

The interview data further revealed that the teachers mainly used teacher-centred approaches (verbal explanation, questioning, discussion, and demonstration) supported by traditional resources (chalkboard, textbooks, and improvised materials), while the use of digital and visual aids remained limited due to infrastructural challenges. Two key themes with sub-themes emerged as follows.

Theme 1: Teachers' Approaches to Teaching Algebra

The theme explored the approaches teachers use in teaching Algebra. The interview responses indicated that the majority of the teachers (8 out of 9) used teacher centred approaches like repetition, memorization as well as discussion, and question and answers

Sub-theme 1: Verbal explanations

This sub-theme revealed that the teachers rely on direct instruction, repetition, and memorization as primary methods used by JHS mathematics teachers in teaching algebra. Many teachers (8 out of 9) explained that they preferred demonstrating algebraic processes step by step, and ensuring that students memorized key formulas before attempting exercises.

One of the teachers hinted:

> *"Most of the time, I explain algebraic concepts on the chalkboard before giving them some of the work as exercise to do." (MT 1, Male, 10 yrs experience)*

Another teacher added:

> *"I solve examples step by step on the board and ask students to copy and do the other questions." (MT 2, Male, 15 yrs experience)*

Similarly, a teacher shared:

> *"I ensure students memorize some of algebra formulas like indices rules before we use them to solve questions." (MT 3, Female, 7 yrs experience)*

In addition, a teacher had this to say:

> *"When students struggle, I repeat the explanation and give more examples until they understand." (MT 5, Male, 12 yrs experience).*

Sub-theme 2: Use of Questioning

The responses also revealed that teachers use questioning techniques to assess students' understanding and guide them in solving algebraic problems. Many teachers (8 out of 9) noted the use of questioning in teaching algebra.

One of the teachers explained:

> *"I ask students to explain their steps when solving algebraic problems on the board." (MT 9, Male, 8 yrs experience)*

Another teacher stated:

> *"When students get a question wrong, I ask them why they think their answer is incorrect and guide them to the correct solution." (MT 6, Male, 10 yrs experience)*

A third teacher mentioned:

> *"I pose open-ended questions to encourage students to think critically before providing answers." (MT 7, Male, 12 yrs experience)*

Additionally, one teacher shared:

> *"I use quick mental questions at the beginning of each lesson to check if what I taught the previous day, they understand." (MT 3, Female, 7 yrs experience)*

Lastly, a teacher stated:

> *"When I see that my students don't understand, let say, algebraic expressions, I ask them simple questions to build their confidence." (MT 1, Male, 10 yrs experience).*

Sub-theme 3: Use of Discussion

It also came out through the interview responses that teacher incorporate discussions into their algebra lessons to promote student participation and peer learning. Most of the teachers (6 out of 9) emphasized that the use of discussions as follows:

One of the teachers shared:

> *"Before introducing a new topic, I ask students to form groups of 5 to talk about what they already know about algebra." (MT 2, Male, 15 yrs experience)*

Another teacher noted:

> *"Sometimes, I allow students to discuss in pairs before answering a question in class." (MT 4, Male, 8 yrs experience)*

A third teacher explained:

> *"I group students and then I write the question on the board. For example, 2x+4=10. Then I allow them to share their ideas and solve it before we discuss them as a class." (MT 5, Male, 12 yrs experience)*

Additionally, one teacher stated:

> *"After solving an equation, I ask students to compare their methods and discuss which one is more efficient." (MT 8, Female, 7 yrs experience*

Lastly, a teacher emphasized:

> *"I encourage students to challenge each other's answers and justify their reasoning during discussions." (MT 1, Male, 10 yrs experience)*

These responses indicate that the teachers use discussions as an integral part of teaching algebra to students in the Akwapim-North Municipality.

Theme 2: Resources Used in Teaching Algebra

This theme explored the various resources JHS mathematics teachers use in teaching algebra. The interview responses revealed that most teachers relied on traditional physical teaching materials, while the use of digital and visual aids was limited due to resource constraints.

Sub-theme 1: Use of Traditional Physical Teaching Resources

The teachers' responses showed that they mostly rely on traditional physical resources including board, textbooks and past questions, bottle tops, and sticks, to support the teaching of algebra. All of the teachers (9 out of 9) emphasized that the use of these resources as follows:

One of the teachers shared:

> *"I mostly use the board and textbooks to explain algebra concepts. I write the examples on the board and solve. Then, I call some to come and solve. After that, I tell them to do other examples in their exercise books" (MT 2, Male, 15 yrs experience)*

Another teacher added:

> *"I go through the past questions from BECE so that I can give my students more practice questions on algebra topics. Those questions actually help them a lot to practice" (MT 3, Female, 7 yrs experience)*

One other teacher hinted:

> *"Sometimes, I use available materials like bottle tops and sticks to demonstrate some of the algebra topics especially when I am teaching about patterns and relations." (MT 6, Male, 10 yrs experience)*

Another teacher shared:

> *"I encourage students to use their exercise books for rough work and do the work step-by-step." (MT 9, Male, 8 yrs experience)*

Lastly, a teacher stated:

> *"Sometimes, I write extra notes on the board for students to copy and revise later." (MT 5, Male, 12 yrs experience)*

Sub-theme 2: Limited Use of Digital and Visual Aids

The responses of the teachers revealed that they rarely use any digital and visual resources including computer, algebra software, mobile phones, projector to support the teaching of algebra. Majority of the teachers (8 out of 9) emphasized occasional use of these digital resources as follows:

One of them responded:

> *"Because we do not have electricity, I do not use any projectors or ICT tools to teach algebra. Just the writings on the board" (MT 4, Male, 8 yrs experience)*

Another teacher added:

> *"I only use my mobile phone to search for more examples and explanations online when I get internet connection. It is not every day that the network works here" (MT 1, Male, 10 yrs experience)*

Similarly, one teacher shared:

> *"I draw diagrams and number lines on the board instead of using printed charts or digital tools." (MT 7, Male, 12 yrs experience)*

In the view of a teacher:

> *"I sometimes encourage students to use their phones to watch educational videos at home, but not all of them have access to the internet." (MT 8, Female, 7 yrs experience)*

The findings from research question two show that JHS mathematics teachers in the Akwapim-North Municipality mainly teach algebra through discussion, question-and-answer, and memorization. They rely mostly on the board, textbooks, past questions, and simple materials such as bottle tops and sticks. Both the quantitative and interview data confirm that teaching is largely teacher-led, even when interactive methods are used. The use of digital tools, problem-solving strategies, and practical resources is very limited due to lack of materials. This means that although teachers are aware of other teaching approaches, they continue to depend mostly on traditional methods.

4.4 Research Question 3: How confident are JHS mathematics teachers in teaching algebra in the Akwapim-North Municipality?

The purpose of this research question was to find out the level of confidence of JHS mathematics teachers in teaching algebra in the Akwapim-North Municipality. Descriptive statistics, including mean and standard deviations were applied for the data analysis. For confidence level, 0–3 (low) indicates low confidence, 4–6 (moderate) shows moderate confidence, and 7–10 (high) reflects high confidence in ability. For the overall confidence level, a score of 0– 33 (low confidence), 34–66 (moderate confidence), and 67–100 (high confidence). The results are presented on Table 6.

Table 6 outlines the pedagogical approaches JHS mathematics teachers use when teaching algebra (N = 83). It reports how many teachers agreed they use each approach and the corresponding percentages.

Table 4.7: Teachers' Level of Confidence

Statements (How much confident do you have in your….)	Mean	Std. Dev.	Level of Confidence
Ability to effectively teach and help your learners succeed in solving questions on algebra?	7.92	0.87	High
Ability to create lessons that actively engage your learners and maintain their interest in learning algebra?	8.25	1.02	High
Ability to design assessments that accurately measure learners' understanding of algebra?	8.08	0.65	High
Ability to identify learners' challenges and misconceptions in algebra and provide effective solutions?	8.24	1.02	High
Ability to mentor and support newer teachers in teaching algebra?	8.01	0.82	High
Ability to get motivated to try new approaches to teaching algebra?	7.77	1.09	High
Ability to be motivated upon colleagues' constructive feedback and praise of your lesson on algebra?	7.70	1.48	High
Ability to be motivated upon mentor's/supervisor's words of encouragement and recognition of your lesson on algebra?	8.01	1.16	High
Ability to manage stress and maintain composure, in handling challenging aspects of algebra?	7.84	0.90	High
High energy levels and can adjust teaching approach to ensure learner engagement during lessons on algebra?	7.84	0.80	High
Overall Level of Confidence	**7.97**	**0.98**	**High**

Source: Field Survey, (2024)

The results in Table 4.7 indicate that JHS mathematics teachers in the Akwapim-North Municipality reported a high level of confidence in teaching algebra. Teachers reported high confidence in their ability to teach algebra effectively and support learners in solving algebraic problems (M = 7.92, SD = 0.87). The low standard

deviation suggests that responses were consistent across teachers, indicating a shared strong belief in their teaching ability. Their highest-rated confidence area was in creating lessons that actively engage learners and maintain their interest in algebra (M = 8.25) demonstrating a strong sense of capability in lesson design, though with some teachers shared contrary opinions (SD = 1.02). Additionally, teachers expressed a high confidence in designing assessments that accurately measure learners' understanding of algebra (M = 8.08, SD = 0.65), with a low standard deviation indicating a high level of agreement among them. Similarly, their ability to identify learners' challenges and misconceptions in algebra and provide effective solutions was rated highly (M = 8.24), with variations in responses (SD = 1.02).

Regarding mentoring, teachers showed high confidence in supporting newer teachers in teaching algebra (M = 8.01, SD = 0.82), with consistency in responses. Similarly, their confidence in trying new approaches to teaching algebra (M = 7.77) was high with a high standard deviation (SD=1.09), indicating that some teachers may be slightly hesitant to experiment with innovative methods. Likewise, their ability to be motivated by colleagues' constructive feedback and praise (M = 7.70, SD = 1.48) had high mean score and the high variation, suggesting that while some teachers respond well to peer feedback, others may be less receptive. In addition, teachers were more confident in responding positively to encouragement and recognition from mentors and supervisors (M = 8.01, SD = 1.16), though with variability in responses.

Teachers also reported high confidence in managing stress and maintaining composure when handling challenging aspects of algebra (M = 7.84, SD = 0.90), with responses being consistent. Similarly, they expressed strong confidence in maintaining high energy levels and adjusting teaching approaches to ensure learner engagement (M = 7.84) with a shared opinion among them (SD = 0.80). The overall high confidence

level (M = 7.97, SD = 0.98) confirms that most teachers highly believe in their ability to teach algebra effectively.

The finding based on this research question is that JHS mathematics teachers in the Akwapim-North Municipality reported high confidence in teaching algebra, with particular strength in creating engaging lessons, identifying misconceptions, mentoring new teachers and getting motivated to teach algebra.

The interview data further revealed that teachers' high confidence in teaching algebra was largely influenced by their strong content knowledge, long years of teaching experience, positive learner feedback, and access to supportive resources and training. These factors are discussed thematically as follows.

Theme 1: Strong Content Knowledge

This theme showed that teachers' high confidence level in teaching algebra was largely influenced by their solid understanding of the subject matter. Many teachers (6 out of 9) explained that when they have a deep grasp of algebra concepts, they are able to teach with ease and respond to students' questions without fear.

One teacher explained:

> *"As for algebra, I know most of the topics very well. So when I'm teaching, I don't panic. Even when a student asks a question, I can break it down for them." (MT 1, Male, 10 yrs experience)*

Another teacher added:

> *"Because I understand the content, I don't struggle when teaching. It makes me confident in front of the class." (MT 7, Male, 12 yrs experience)*

Lastly, a teacher shared:

> *"When you know the topic well, you don't fear standing in front of the children. It gives you courage to explain in many ways." (MT 9, Male, 8 yrs experience)*

Theme 2: Teaching Experience

Five of the teachers also highlighted that the number of years they have been in the profession builds their confidence in handling algebra. The more years they spend teaching, the more strategies they develop to handle learners' difficulties.

One teacher shared:

> *"After teaching for many years, I have seen different ways students struggle. So now I know how to handle them, and this makes me confident." (MT 2, Male, 15 yrs experience)*

Another teacher mentioned:

> *"With the experience I have, I don't fear teaching algebra. Even if the topic looks hard, I can manage it." (MT 5, Male, 12 yrs experience))*

A final remark was given that:

> *"Every year I learn something new from my students. That experience builds me up, so I enter the classroom without fear." (MT 6, Male, 10 yrs experience)*

Theme 3: Positive Learner Feedback and Engagement

Only three of the teachers linked their confidence levels to how learners respond during lessons. When students participate actively and show understanding, teachers feel more encouraged and assured in their teaching.

One teacher explained:

> *"When you teach and the students are answering your questions well, you become happy and you know you are doing well. It boosts your confidence." (MT 4, Male, 8 yrs experience)*

Another teacher remarked:

> *"When the children show interest in the algebra lesson, I also feel motivated. Their participation gives me confidence to continue." (MT 8, Male, 10 yrs experience)*

Lastly, a teacher revealed:

> *"Imagine as you teach, the learners understand and even clap for you, you know you have done well. That alone makes you more confident the next time." (MT 3, Female, 7 yrs experience)*

Theme 4: Supportive Teaching Resources and Training

Some teachers (4 out of 9) also mentioned that training workshops and the availability of textbooks and teaching aids helped them to prepare well, which in turn boosted their confidence in teaching algebra.

One teacher said:

> *"One of the workshops I attended, the facilitator really helped us, I shared some of my difficulties for this same algebra topic and he gave us new ideas. This made me feel bold to teach algebra because I have more strategies to use." (MT 7, Male, 11 yrs experience)*

A second teacher noted:

> *"The textbooks and materials we use also help me. When I prepare well with them, I feel confident in class." (MT 8, Female, 6 yrs experience)*

Another teacher concluded:

> *"Anytime we are trained or given materials, I try to use it my teaching and I don't get any fears because I know what to do and how to do it." (MT 1, Male, 10 yrs experience)*

The findings from the interview suggest that teachers' confidence in teaching algebra was shaped by four key factors. First, strong content knowledge gave them mastery of concepts and reduced fear. It also helped them explain lessons in different ways. Second, years of teaching experience exposed them to learner difficulties and ways to address them, making them more assured. Third, positive learner feedback and engagement motivated them, as students' interest showed their teaching was effective. Finally, access to teaching resources and training boosted confidence with fresh ideas

and materials. Together, these factors strengthened teachers' courage and self-assurance in teaching algebra.

4.5 Research Question 4: What challenges confront JHS mathematics teachers in teaching algebra in the Akwapim-North Municipality?

This question aimed to identify the challenges that confront JHS mathematics teachers in teaching algebra in the Akwapim-North Municipality. The responses were analysed using frequency, percentages, mean and standard deviation. The mean score was calculated with the formular; mean ($\bar{x}$) = 1 + 2 + 3 + 4 = 10/4 =2.5. Therefore, a mean score above 2.5 implies that the majority of the respondents agreed to the statement while ($\bar{x}$) less than 2.5 implies that the majority of the respondents disagreed with the statement. For the standard deviation, an obtained value below 1.0 indicates the similarity of the responses given to the item while a standard deviation 1.0 or above indicate the variation in the responses given. The results are presented on Table 4.8.

Table 4.8 summarizes the perceived challenges in teaching algebra reported by the teachers (responses show number and percent who agree/disagree, with means and standard deviations).

Table 4.8: Challenges in Teaching Algebra

Statements **(Challenges in teaching algebra)**	Frequency N (%)				
	N	**AG**	**DG**	**M**	**SD**
Difficulty relating algebraic concepts to everyday life of learners.	83	48 (58)	35 (42)	2.71	0.76
Difficulty getting instructional resources on algebraic topics.	83	76 (92)	7 (8)	4.35	0.78
Lack of adequate in-service training programmes on algebra in my district.	83	73 (88)	10 (12)	4.24	0.83
Difficulty in factorizing difference of two squares.	83	28 (34)	55 (66)	2.01	0.81
Difficulty in expanding more than one term bracket.	83	63 (76)	20 (24)	3.18	0.89
Difficulty in expanding more than one term exponential equations.	83	42 (51)	41 (49)	2.65	0.94
Difficulty in applying the laws of indices.	83	25 (30)	58 (70)	2.01	0.53
Difficulty in applying PEDMAS/BODMAS rule for order of operations.	83	21 (25)	62 (75)	2.18	0.89
Difficulty in representing algebraic task in word problems.	83	70 (84)	13 (16)	4.08	0.74
Difficulty in translating algebraic word problems to arithmetic forms.	83	77 (93)	6 (7)	4.43	0.62

Key: Agree (AG), Disagree (DG), Mean (M), Std. Dev (SD)

Source: Field Survey, (2024)

The data in Table 4.8 reveal several challenges that Junior High School mathematics teachers face in teaching algebra in the Akwapim-North Municipality. A notable challenge is the difficulty in relating algebraic concepts to the everyday lives of learners (M = 2.71, SD = 0.76), with 58% of teachers agreeing. The relatively low standard deviation suggests a moderate level of agreement among respondents. The most widely reported challenge was the difficulty in obtaining instructional resources for teaching algebraic topics (M = 4.35, SD = 0.78), with 92% of teachers

acknowledging this issue. Similarly, a significant majority (88%) agreed that inadequate in-service training programs on algebra in the district (M = 4.24, SD = 0.83) posed a challenge.

Regarding specific algebraic operations, 76% of teachers found it difficult to expand expressions involving more than one bracket (M = 3.18, SD = 0.89), while 51% encountered challenges with expanding exponential equations (M = 2.65, SD = 0.94). The latter had a higher standard deviation, reflecting greater variation in responses. However, difficulties with factorizing the difference of two squares (M = 2.01, SD = 0.81) and applying the laws of indices (M = 2.01, SD = 0.53) were not as widely reported, with the majority of teachers disagreeing. Likewise, applying the PEDMAS/BODMAS rule for the order of operations (M = 2.18, SD = 0.89) was not perceived as a major challenge.

Challenges were also identified in the area of word problem representation and translation. A significant 84% of teachers reported difficulty in representing algebraic tasks in word problems (M = 4.08, SD = 0.74), and an even higher 93% acknowledged struggling with translating algebraic word problems into arithmetic forms (M = 4.43, SD = 0.62). These high mean scores suggest that these difficulties are prevalent among teachers.

Based on research question three, the findings indicate that while JHS mathematics teachers in the Akwapim-North Municipality face general challenges in teaching algebra, the most pressing issues relate to difficulties in translating algebraic word problems to arithmetic forms (M = 4.43, 93% agreement), inadequate instructional resources (M = 4.35, 92% agreement), limited professional training (M = 4.24, 88% agreement), difficulties in representing algebraic tasks in word problems(M

= 4.08, 84% agreement), and difficulties in expanding more than one term bracket (M = 3.18, 76% agreement).

The interview responses further revealed that the challenge teachers face in teaching algebra are attributable to factors including lack of prerequisite knowledge, resource constraint and language barriers.

Theme 1: Poor Students' Understanding of Related Algebra Topics

The teachers hinted that many of their students struggle with algebra due to weak foundational knowledge in other related mathematics topics. Some interview responses supporting this claim are provided below

One of the teachers shared:

> *"Most of my students struggle with algebra because they do not even understand other topics that we use when teaching algebra like fractions, indices and BODMAS rules." (MT 9, Male, 8 yrs experience)*

A teacher equally added:

> *"They find it difficult to tell the difference between constant and variables, which makes it difficult for them to change word problems into algebraic expressions." (MT 1, Male, 10 yrs experience)*

Lastly, a teacher mentioned:

> *"I have seen that for them to change algebraic questions in word problems is difficult because they have not been taught addition, subtraction, multiplication and division, which they are not taken through well enough at the lower levels." (MT 3, Female, 7 yrs experience)*

Theme 2: Inadequate Instructional Resources

All the teachers (9 out of 9) mentioned that limitation in access to teaching and learning materials makes it difficult for them to effectively teach algebraic topics to learners in practical ways.

One teacher had this to say:

> *"Most of my students don't even have textbooks, so they use what we write on the board, which is not enough for them. They need to solve more examples on their own." (MT 4, Male, 8 yrs experience)*

Another teacher shared:

> *"We do not have teaching materials like algebra tiles or any digital tools, which would help them to see what we are teaching and visualize the abstract concepts." (MT 2, Male, 15 yrs experience)*

One teacher also lamented:

> *"Those of us in rural areas like this do not even have enough chalk. How then can we even get projectors or computers for teach our algebra topics. All these are part of reasons" (MT 7, Male, 12 yrs experience)*

Lastly, a teacher added to the earlier response sharing:

> *"Trust me, if we get access to online platforms and mathematics software, I think it will make students to like the topic and be more involved in algebra lessons." (MT 8, Female, 7 yrs experience)*

Theme 3: **Language Barrier**

The majority of the teachers (6 out of 9) also shared that English language is a factor that affects students' ability to understand algebraic word problems. Some supporting excerpts are provided below:

A teacher stated:

> *"Many of my people sometimes do not understand algebraic word problems because they are written in English using words and not numbers, which they have to now change back to numbers before they solve, that's the word problems." (MT 3, Female, 7 yrs experience)*

Another teacher added to it saying:

> *"If I explain the problem in Twi, they understand the topic better, but since questions are in English, they still struggle during tests or exams." (MT 5, Male, 12 yrs experience)*

One other teacher said:

> *"Some of the word problems, they use difficult words, so the students get confused as to what they are even looking for since they do not understand those words used." (MT 6, Male, 10 yrs experience)*

Lastly, a teacher mentioned:

> *"They also sometimes misinterpret the questions, they use the wrong operations, which makes the solution wrong." (MT 2, Male, 15 yrs experience)*

4.6 Research Hypothesis: There is no statistically significant difference between teachers' years of experience and their confidence for teaching algebra in the Akwapim-North Municipality

This question hypothesis was to examine the influence of JHS teachers' years of mathematics teaching experience on their confidence for teaching algebra in the Akwapim-North Municipality. The aim was to determine whether there was a statistically significant difference in the teachers' confidence in teaching algebra based on their years of teaching mathematics. The differences were tested using the One-Way Analysis of Variance (ANOVA) test to compare the mean scores of respondents at an alpha level of .05.

Prior to the use of this test, various assumptions were tested. First, the data was tested for Homogeneity of Variances assumption by inspecting Levene's test. The results are presented in Table 8.

Table 8 reports the Levene test for homogeneity of variances (based on the mean) used to check whether group variances are equal

Table 4.9: Test of Homogeneity of Variances

	Levene Statistic	df1	df2	Sig.
Based on Mean	2.985	3	83	.804

Source: Field data (2024)

Table 4.9 shows that the test for homogeneity of variances assumption was based on Levene's test was not significant (p =.034). The non-significant value suggests that variances within the factor across years of experience are assumed equal and hence, homogeneity of variances assumption was not violated.

Secondly, the level of scale of measurement of the data was checked. This assumption was met because the study employed a 10-point self-efficacy Likert scale, measured at the interval scale. This approach is consistent with the requirements for the two tests, as it provides an interval level of measurement that is necessary for this type of statistical analysis. (Refer to Appendix A)

Again**,** a test of no significant outliers in the data was checked using a box and whisker plot to visually inspect for any extreme values. The results are shown on Figure 4.3

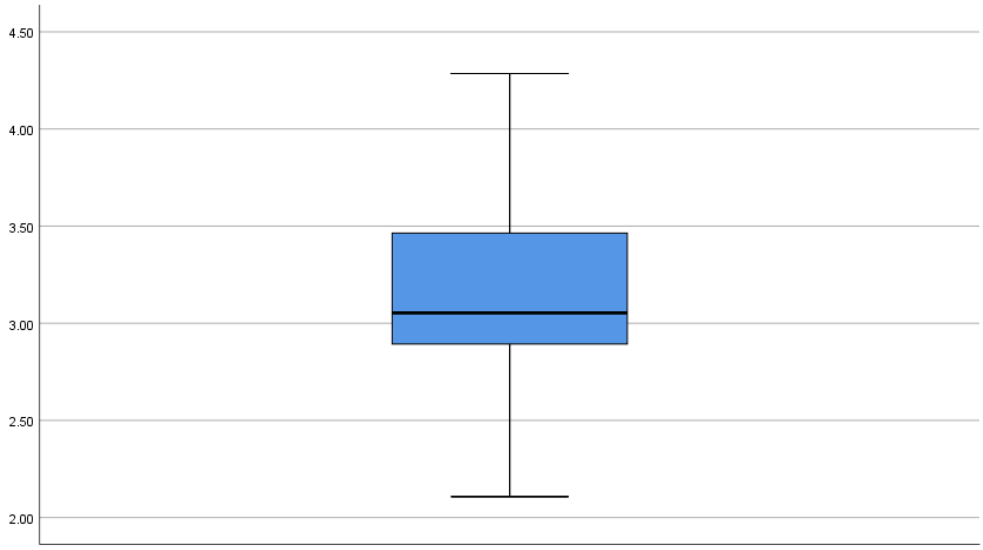

Fig. 1: Box plot for outliers

From Fig. 1, it shows that there were no data points falling outside the whiskers, either above or below it. Since there are no points outside the whiskers, it indicates that there are no outliers in the data. Therefore, the assumption of no outliers is met.

Moreover, the test of normality was also conducted and the results are presented on Table 4.10.

Table 4.10 presents the Shapiro–Wilk test of normality conducted to determine whether the data for each teaching-experience group are normally distributed.

Table 4.10: Test of Normality

	Shapiro-Wilk		
Highest Qualification of Teachers	Statistic	df	Sig.
1-5 years	.919	41	.448
6-10 years	.731	21	.236
11-15 years	.888	7	.087
16 years and above	.939	14	.401

* This is a lower bound of the true significance.
(**Source: Field data (2024)**

Table 4.10 unveiled that the test for normality was done using Shapiro-Wilk's test. The test revealed that the data was not significant across the various levels of teaching experience as follows: 1-5 years (p =.448), 6-10 years (p =.236), 11-15 years (p =.087), and 16 years and above (p =.401). The non-significant value means that data was normally distributed across teaching experiences. Hence, the assumption of normality was found tenable.

Since the assumptions of normality, homogeneity of variance, scale of measurement, and no significant outliers were all met, the use of ANOVA test was deemed applicable. Hence, the researcher proceeded to conduct this test.

As part of the test of Analysis of Variance (ANOVA), the descriptive statistics for each qualification level is presented in Table 4.11. Table 4.11 reports descriptive

statistics for teachers' level of confidence by years of teaching mathematics. Each experience group's sample size, mean score, and standard deviation are shown

Table 4.11: Descriptive Statistics

	N	Mean	Std. Deviation	Level of Confidence
1-5 years	41	7.85	.910	High
6-10 years	21	8.33	.483	High
11-15 years	7	8.00	.080	High
16 years and Above	14	7.50	.519	High
Total	**83**	**7.93**	**.762**	**High**

Source: Field data (2024)

The post-hoc comparisons using the Tukey HSD test in Table 10 revealed that the highest mean score was recorded for teachers with 6-10 years of Mathematics teaching experience (M = 8.33, SD = 0.48), followed by 11-15 years (M = 8.00, SD = 0.80), 1-5 years (M = 7.85, SD = 0.91), and finally 16 years and above (M = 7.50, SD = 0.52). Based on the means score which were all within a confidence score range of 7 to 10, it was concluded that teachers across the different years of mathematics teaching experience all exhibited a high level of confidence for teaching algebra in the Akwapim-North Municipality. It is therefore possible that there might not be any significant difference in their level of confidence since their confidence level across all years of mathematics teaching experience were same and generally high.

To see whether or not there is a statistically significant difference JHS teachers' level of confidence for teaching algebra based on their years of mathematics teaching experience, a One-Way ANOVA test was conducted. The results are shown on Table 4.12.

Table 4.12 shows the one-way ANOVA testing whether overall confidence differs across the four experience groups. It reports the sum of squares, degrees of freedom, mean squares, the F statistic, and the significance value.

Table 4.12: ANOVA Results

ANOVA

Overall Confidence Level

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	6.278	3	2.093	0.004	.072
Within Groups	41.289	79	.523		
Total	47.566	82			

Source: Field data (2024)

The One-Way ANOVA results in Table 4.12 examine whether there is a statistically significant difference in JHS mathematics teachers' confidence levels in teaching algebra based on their years of teaching experience. The F-value of 0.004 indicates almost no variation between groups, and the p-value (Sig.) of 0.072 is above the conventional significance threshold of 0.05. This suggests that there are no statistically significant differences in confidence levels across different experience groups. Since the F-value is close to zero, it implies that the mean confidence levels among teachers with different years of experience are nearly identical. This result suggests that teaching experience does not significantly influence teachers' confidence in teaching algebra within this study.

It is therefore concluded that there is no significant difference in teachers' confidence levels based on their years of teaching experience. Hence, the researcher fail to reject the null hypothesis (H_0). This means the study supports the claim that regardless of their years of experience, JHS mathematics teachers in the Akwapim-North Municipality exhibit similar levels of confidence in teaching algebra.

4.7 Discussion of Findings

Research Question 1: Level of Content Knowledge for Teaching Algebra among JHS Mathematics Teachers in Akwapim-North Municipality

The findings for research question one indicate that the majority of JHS mathematics teachers (57.8%) in the Akwapim-North Municipality have a moderate level of content knowledge for teaching algebra. A closer look shows that while 74.7% demonstrated strong common content knowledge and 84.3% exhibited high horizon content knowledge, more than half (57.8%) had low levels of specialized content knowledge. The interview data confirmed this pattern: teachers reported confidence in teaching topics such as Patterns and Relationships, Algebraic Expressions, Variables, and Linear Equations, often relying on real-life examples like money, food, and everyday activities to support explanations. However, they admitted struggling with Quadratic Equations, Simultaneous Equations, Word Problems, and Inequalities.

The findings of the present study show that many Junior High School (JHS) mathematics teachers possessed strong common and horizon content knowledge, but their specialized content knowledge of algebra was relatively weak. This pattern is consistent with previous research that examined teachers' algebra knowledge and its influence on instructional effectiveness. For example, Watkins (2018), using the Knowledge of Algebra for Teaching (KAT) framework in the United States, observed that both preservice and in-service teachers had comparable levels of algebra knowledge, though preservice teachers appeared slightly more proficient. This suggests that while teaching experience enhances general algebra knowledge, targeted training and professional learning opportunities are needed to improve the specialized knowledge required for effective classroom instruction.

Similarly, Yılmaz and Erbaş (2017) found that middle school mathematics teachers demonstrated competence in switching between different algebraic representations, but many struggled with in-depth specialized content knowledge. This finding resonates with the present study, as JHS teachers also showed gaps in their ability to deeply explain algebraic concepts, a weakness that could affect students' conceptual understanding and progression in algebra.

Donkor (2020), working within the Ghanaian context, also revealed that Senior High School (SHS) preservice teachers demonstrated stronger algebra knowledge than in-service teachers. This raises concerns about whether ongoing professional training for experienced teachers sufficiently addresses the needs of classroom practice. The situation in the current study mirrors this concern, since a significant proportion of JHS teachers displayed limited specialized knowledge of algebra, reinforcing the importance of continuous and targeted professional development.

Further evidence from Osei and Kubi (2022) showed that professional mathematics teachers in Ghana had stronger algebra teaching knowledge than non-professional counterparts. While the JHS teachers in this study possessed strong general content knowledge, gaps in specialized content knowledge may have restricted their effectiveness in teaching algebra. These discrepancies could stem from variations in teacher preparation, differences in exposure to advanced algebraic content, and limited access to subject-specific professional training.

Contrary to the relatively positive trends in common content knowledge, studies by Yildiz and Yetkin Özdemir (2021) in Turkey highlighted persistent weaknesses in teachers' knowledge of algebraic concepts such as variables, algebraic expressions, and equations. Their findings indicated that inadequate content knowledge limited teachers' ability to give clear explanations, often leading to misconceptions among students.

Similarly, Entsie (2021), studying preservice teachers in Ghana, reported that their overall knowledge of algebra for teaching was weak, suggesting that both preservice and in-service teachers may require additional preparation and training to achieve mastery.

Taken together, these findings point to the urgent need for professional development programs focused on enhancing specialized algebra knowledge. With more than half (57.8%) of teachers in this study showing low levels of specialized knowledge, training initiatives should emphasize algebra-specific pedagogical strategies, deepened understanding of algebraic structures, and problem-solving techniques. Evidence from Donkor (2020) and Entsie (2021) further suggests that even preservice teachers are not immune to such knowledge gaps, highlighting the importance of strengthening teacher education curricula to ensure graduates are fully prepared to teach algebra effectively.

The literature also reinforces the potential impact of teachers' content knowledge on student learning. Weaknesses in specialized knowledge can hinder students' ability to make connections across representations and increase the risk of misconceptions, as observed by Yildiz and Yetkin Özdemir (2021). In contrast, the relatively strong horizon content knowledge (84.3%) demonstrated by teachers in the current study presents an opportunity for peer learning and mentorship. More experienced teachers with strong common and horizon content knowledge could collaborate with colleagues to enhance specialized knowledge through joint lesson planning, reflective practices, and peer coaching.

It is concluded that the study finds that while JHS mathematics teachers in Akwapim-North Municipality possess moderate overall content knowledge, their low specialized content knowledge poses a challenge for effective algebra instruction. This

finding aligns with previous research, which has consistently highlighted variations in teachers' knowledge levels across different contexts.

Research Question 2: Pedagogical Approaches Used By JHS Mathematics Teachers in Teaching Algebra in Akwapim-North Municipality

The study found based on research question two that JHS mathematics teachers in the Akwapim-North Municipality use pedagogical approaches such as group work, verbal explanation, class discussion, and demonstration when teaching algebra. Regarding instructional resources, they primarily rely on traditional physical materials, including the board, textbooks, past questions, bottle tops, and sticks, to support algebra instruction. However, they rarely incorporate digital and visual resources such as computers, algebra software, mobile phones, or projectors in their teaching.

These findings align with previous research that emphasizes the role of discussion-based approaches in algebra instruction. Powell (2015) emphasizes that effective algebra teaching requires teachers to consider students' prior knowledge when designing tasks, and group activities allow learners to negotiate solutions and reinforce understanding through interaction. In addition to collaboration, teachers rely heavily on verbal explanations to convey algebraic concepts. According to Powell (2015), carefully structured explanations combined with questioning help students internalize procedures and concepts; however, over-reliance on repetition and memorization may emphasize procedural fluency at the expense of conceptual understanding, limiting students' ability to apply knowledge flexibly, as noted by Baidoo and Ali (2023).

Class discussions are also used to encourage reasoning and the analysis of solutions. Star et al. (2015) indicate that presenting fully worked-out problems for student analysis enhances understanding, while Arcavi and colleagues (2017) highlight

that discussing intentional errors fosters error-analysis skills and strengthens conceptual grasp. In the current study, however, discussions often focus on procedural routines rather than deep conceptual exploration, which may constrain students' algebraic reasoning. Demonstration, where teachers illustrate steps to solve problems, provides students with models to follow. Kenney and Silver (1997) found that students may struggle with fundamental algebraic tasks if demonstrations emphasize procedures over understanding. The present study also shows that demonstrations are largely restricted to traditional materials, with minimal use of digital or interactive tools that can enhance conceptual learning, such as computer algebra systems or virtual manipulatives, as suggested by Rakes et al. (2010) and Arcavi et al. (2017).

The limited integration of technology reflects a significant gap in modern teaching practices, possibly due to restricted access, inadequate training, or reluctance to adopt new tools. Research indicates that technology can enhance conceptual understanding, engagement, and problem-solving skills in algebra, especially when interactive tools are used (Rakes et al., 2010; Kaput, 2002). Overall, the findings suggest a need to shift from traditional, teacher-centered approaches toward student-centered, conceptually focused instruction. While group work, verbal explanation, class discussion, and demonstration remain valuable strategies, excessive reliance on repetition and procedural teaching may hinder students' critical thinking and problem-solving abilities. Watkins (2018) emphasizes that teachers should be equipped with diverse instructional strategies, including digital tools, to enhance algebra teaching, while Tiğli (2023) notes that interactive, technology-driven approaches can improve student engagement and reduce learning difficulties.

However, studies have shown that an over-reliance on memorization and procedural teaching can hinder students' problem-solving abilities. Baidoo and Ali

(2023) found that many students learning algebra focus on memorizing solutions rather than developing a conceptual understanding. As a result, when faced with problems requiring the use of variables to represent unknowns, students often struggle to apply their knowledge flexibly. Similarly, Kenney and Silver (1997) discovered that even twelfth-grade students struggled with fundamental algebraic tasks such as solving equations, converting verbal descriptions into symbolic expressions, and articulating reasoning. These difficulties suggest that an excessive focus on rote learning and procedural knowledge could limit students' algebraic reasoning skills.

The findings suggest the need for a shift from traditional, teacher-centered approaches toward more student-centered, conceptual teaching methods in algebra instruction. While questioning and discussion are essential strategies, over-reliance on repetition and memorization may limit students' ability to think critically and apply algebraic concepts flexibly. Watkins (2018) emphasized that mathematics teachers must be equipped with diverse strategies to address misconceptions and promote conceptual understanding. Additionally, the study suggests a need for enhanced professional development programs that train teachers to integrate technology-based teaching tools into algebra instruction.

Given the increasing availability of digital tools, professional training programs should focus on helping teachers effectively utilize computer-based algebra systems, mobile learning applications, and interactive software to support learning. Moreover, since research suggests that students often disengage from mathematics due to difficulties in learning algebra through traditional methods (Kaput, 2002; Tiğli, 2023), adopting interactive and technology-driven approaches could improve student engagement and reduce dropout rates in mathematics courses.

It is argued therefore that JHS mathematics teachers in the Akwapim-North Municipality primarily rely on traditional pedagogical approaches, with limited integration of technology in algebra instruction. While class discussion, demonstration and questioning methods are widely used, the focus on repetition and memorization suggests a need for more conceptual teaching approaches that emphasize problem-solving and critical thinking. The lack of digital resources in algebra teaching poses a challenge to modernizing mathematics instruction. To enhance algebra teaching and learning, there is a need for pedagogical training, increased access to digital tools, and a shift toward interactive, student-centered teaching strategies.

Research Question 3: Confident Level of JHS mathematics teachers in teaching algebra in Akwapim-North Municipality

The findings based on research question three indicate that JHS mathematics teachers in the Akwapim-North Municipality reported high confidence in teaching algebra. In particular, they expressed strong confidence in aspects of their teaching related to creating engaging lessons, identifying misconceptions, mentoring new teachers, and maintaining motivation to teach algebra. Further insight from the interview revealed that teachers' high confidence in teaching algebra was shaped by four main factors. First, strong content knowledge gave teachers mastery over algebra concepts, which reduced fear and allowed them to explain lessons in different ways. Second, teaching experience played a key role, as years in the classroom exposed them to various learner difficulties and strategies for addressing them, making them more assured. Third, positive learner feedback and engagement motivated teachers, as students' interest and participation reassured them that their teaching was effective. Finally, access to supportive teaching resources and professional training further boosted confidence, equipping teachers with fresh ideas and materials to handle algebra

with ease. Together, these factors worked to strengthen teachers' courage and self-assurance in delivering algebra lessons.

These findings align with previous research on teachers' self-efficacy beliefs in mathematics instruction. Kumi (2023) examined self-efficacy among Senior High School mathematics teachers in the Central Tongu District, Ghana, and found that teachers reported high self-efficacy (mean score = 4.57, SD = 0.57). However, the study noted that this high confidence did not translate into improved student performance in final examinations, suggesting that confidence alone may not guarantee effective teaching outcomes.

Similarly, Olawale and Hendricks (2024) investigated factors influencing mathematics teachers' self-efficacy in the Eastern Cape Province, South Africa, including gender, educational background, teaching experience, and school type. The study found that teachers demonstrated high confidence in their instructional strategies, reinforcing the idea that many mathematics teachers perceive themselves as competent in their subject matter.

Further supporting this, Berg et al. (2024) examined the relationship between self-efficacy, teaching profiles, and pedagogical practices among 327 primary school mathematics teachers in New Zealand. Their findings indicated that experienced teachers had significantly higher self-efficacy scores than less experienced teachers. Additionally, teachers with higher self-efficacy were more likely to implement effective pedagogical strategies that enhanced student learning. This suggests that confidence, when paired with strong pedagogical skills, can contribute to better instructional quality.

The confidence level of mathematics teachers is a crucial factor in shaping students' learning experiences and academic outcomes. High self-efficacy among teachers influences their instructional approaches, ability to support struggling learners, and overall classroom engagement. Tschannen-Moran and Woolfolk Hoy (2001) emphasized that self-efficacy determines a teacher's willingness to persist through challenges, which is critical in subjects like algebra, where students often face conceptual difficulties.

Moreover, Künsting, Neuber, and Lipowsky (2016) define teacher efficacy as a teacher's confidence in their ability to enhance student learning, even in difficult conditions. Research suggests that teachers with high self-efficacy are more likely to use innovative teaching methods, adapt their strategies to students' needs, and create a supportive learning environment. Katz and Stupel (2016) further found that higher teacher efficacy is positively correlated with student achievement in mathematics, highlighting the need to sustain and enhance teacher confidence through continuous professional development.

The study confirms that JHS mathematics teachers in the Akwapim-North Municipality exhibit strong confidence in teaching algebra. This aligns with findings from previous research in Ghana, South Africa, and New Zealand, which suggest that mathematics teachers generally report high self-efficacy in their instructional roles. However, while confidence is essential, it must be accompanied by effective pedagogical strategies and student-centered teaching methods to improve learning outcomes. Professional development programs should focus on equipping teachers with evidence-based instructional strategies that complement their confidence and enhance student engagement and performance in algebra.

Research Question 4: Challenges Confronting JHS Mathematics Teachers in Teaching Algebra in Akwapim-North Municipality

Based on research question four, the findings indicate that JHS mathematics teachers in the Akwapim-North Municipality face several key challenges in teaching algebra. The most pressing issues include difficulties in translating algebraic word problems into arithmetic forms, inadequate instructional resources, limited professional training, difficulties in representing algebraic tasks in word problems, and difficulties in expanding more than one term bracket. Additionally, interview responses revealed that these challenges are largely attributed to factors such as a lack of prerequisite knowledge, resource constraints, and language barriers.

These findings reinforce the long-standing view that algebra is one of the most difficult topics in mathematics to both learn and teach (Stephens et al., 2004; Watson, 2017). Algebra is a core component of mathematics education reform, yet students commonly struggle with its concepts, leading to persistent misconceptions and learning difficulties (Blanton et al., 2015). Consequently, teachers face unique instructional challenges when teaching algebra. A study by Osei and Agyei (2024) explored the algebra knowledge and challenges faced by JHS students in both public and private schools in Ghana. The study identified ten significant algebra difficulties, which included translating algebraic word problems into arithmetic forms, representing algebraic tasks in word problems, and expanding more than one-term brackets—all of which were also reported in the current study.

The challenges in expanding algebraic expressions are consistent with findings by Strand and Mills (2014), who noted that students struggle with expanding brackets with multiple terms, exponential expansions, canceling common factors, applying laws of indices, and understanding the order of operations. These persistent difficulties

hinder teachers' ability to support struggling students, as noted by Bush and Karp (2013) and Kieran (2018). Similarly, the difficulties in translating algebraic word problems into arithmetic forms align with findings by Asoma et al. (2022), who emphasized that poor language expression significantly affects problem-solving abilities. Their study found that students often struggle to interpret equations containing both letters and numbers. Das (2019) further observed that many students rely on basic arithmetic algorithms to arrive at answers without fully considering the contextual meaning of algebraic problems. Furthermore, representing word problems algebraically, particularly using variables for unknowns, corresponds with Bair and Rich's (2011) finding that teachers often struggle with tasks requiring variable representation.

The difficulties in representing algebraic tasks in word problems are echoed in Ali and Adu-Poku (2021), who found that students often struggle with translating algebraic expressions into word problems, converting word problems into equations and inequalities, and applying problem-solving strategies. The Ministry of Education (2020) has recommended that students develop a deeper conceptual understanding of algebra beyond classroom instruction, bridging the gap between school-based learning and real-life applications (Adu et al., 2017).

The study identifies three major factors contributing to the challenges in teaching algebra. First, the lack of prerequisite knowledge aligns with Bertrand and Marsh (2015), who suggested that teachers often attribute students' difficulties to prior learning experiences and instructional approaches used by their former teachers. Second, while resource constraints were mentioned in the study, further research is needed to support this claim. Third, the issue of language difficulties was also reported by Asoma et al. (2022). Poor language comprehension hinders students' ability to

understand and solve algebraic problems, particularly in interpreting equations containing both letters and numbers. Das (2019) found that many students apply mechanical arithmetic procedures without grasping the underlying problem structure, reinforcing the impact of linguistic challenges on algebra learning.

These challenges may partially explain students' poor performance in algebra at the Basic Education Certificate Examination (BECE) level. Osei and Kubi (2022) reported that students in Ghana's basic schools have consistently shown weak proficiency in algebra-related questions over the years. This pattern has significantly contributed to the overall poor performance of students in the BECE for nearly a decade. Additionally, reports from the chief examiners of the BECE (2011–2018) consistently highlighted several algebra-related difficulties, including managing variables, particularly when more than one is involved, correctly removing brackets, especially nested ones or those containing exponents, solving algebraic fraction problems, applying the BODMAS rule accurately, and simplifying algebraic expressions. These findings confirm the broader issue of algebraic misconceptions and difficulties, as discussed by Blume (2000), the RAND Mathematics Study Panel (2003), and Willmot et al. (2018).

The findings suggest a persistent challenges in teaching algebra among JHS mathematics teachers in the Akwapim-North Municipality. These challenges are consistent with global research on algebra instruction. Major difficulties include translating word problems, representing algebraic tasks, and expanding expressions, all of which hinder effective teaching and learning. Addressing these challenges requires targeted professional development programs to enhance teachers' pedagogical skills in algebra instruction, improved instructional resources to support interactive and problem-solving approaches, language-support strategies to help students comprehend

and apply algebraic concepts, and a stronger emphasis on foundational mathematical skills in earlier grades to improve prerequisite knowledge. By addressing these barriers, teachers will be better equipped to support students, ultimately improving algebra proficiency and overall mathematics performance

Research Hypothesis: There is no statistically significant difference between teachers' years of experience and their confidence for teaching algebra in the Akwapim-North Municipality.

This study found that there is no significant difference in teachers' confidence levels based on their years of teaching experience. Hence, the researcher fail to reject the null hypothesis (H_0). This means that regardless of the years of experience, JHS mathematics teachers in the Akwapim-North Municipality exhibit similar levels of confidence in teaching algebra.

These findings align with those of Osei and Kubi (2022), who examined the algebra knowledge of professional and non-professional basic school mathematics teachers in Ghana. Their study, grounded in the Knowledge of Algebra for Teaching (KAT) framework, assessed teachers' School Algebra Knowledge, Advanced Algebra Knowledge, and Algebra Teaching Knowledge. The results indicated that neither professional nor non-professional teachers showed significant improvement in algebra teaching knowledge with increased years of experience. This suggests that experience alone may not necessarily enhance teachers' confidence in teaching algebra without targeted professional development and continuous learning opportunities.

Surprisingly, the current findings contrast with those of Bjerke and Xenofontos (2024), who conducted a cross-sectional study examining changes in self-efficacy among primary mathematics teachers at different career stages. Their study included novice and experienced pre-service teachers (PSTs) and in-service teachers (ISTs),

revealing that self-efficacy in teaching mathematics tends to increase with experience. Similarly, Berg et al. (2024) investigated the relationship between teachers' self-efficacy in teaching mathematics (SETM), their teaching profiles, and pedagogical practices using data from 327 primary teachers in New Zealand. Their findings indicated that experienced teachers had significantly higher SETM scores than their less experienced counterparts, further supporting the idea that confidence in teaching mathematics tends to improve with years of experience.

Generally, teaching experience is considered a significant factor in shaping teachers' self-efficacy. Studies have shown that experienced teachers often report higher confidence in their ability to manage diverse classroom situations, implement effective teaching strategies, and adapt to students' needs. However, the extent to which experience influences self-efficacy depends on the quality of teaching practice, exposure to professional development, and ongoing instructional support. Klassen et al. (2011) emphasized that teachers who actively engage in reflective practice and seek continuous improvement are more likely to develop higher self-efficacy.

The present study's findings suggest that in the context of JHS mathematics teachers in the Akwapim-North Municipality, teaching experience alone does not necessarily translate into greater confidence in teaching algebra. This could indicate the need for more structured professional learning programs tailored to algebra instruction. Future research could explore other contributing factors to teachers' confidence, such as access to professional development, mentoring opportunities, and institutional support systems that enhance teachers' pedagogical skills in algebra instruction.

CHAPTER FIVE

SUMMARY OF FINDINGS, CONCLUSIONS, AND RECOMMENDATIONS

5.0 Overview

This chapter gives the summary of findings, conclusions, recommendations, and suggestions for future research.

5.1 Summary of the Study

The purpose of this study was to assess Junior High School Mathematics teachers' knowledge and confidence for teaching algebra in the Akwapim-North Municipality of Ghana. The study was grounded in Ball's Mathematical Knowledge for Teaching (MKT) and Bandura's Self Efficacy Theory. Guided by four research questions, the study employed a mixed method approach, using a sequential explanatory as its design. The sample size was 83 JHS Mathematics teachers. These teachers were selected through a census frame during the quantitative phase. Purposive sampling technique was used to select teachers for the qualitative data. Data were collected using a structured questionnaire and semi-structured interview guide. Descriptive data analysis techniques, including simple frequency counts, percentages, mean, and standard deviation, were used to analyze data for research question one, three and four while ANOVA test was used utilized to analyze the data for research hypothesis. Thematically analysis was used for research question 2 and 4. The analysis aimed to answer these research questions and hypothesis:

1. What is the level of content knowledge for teaching algebra among JHS mathematics teachers in the Akwapim-North Municipality?
2. What pedagogical approaches do JHS mathematics teachers employ in teaching algebra in the Akwapim-North Municipality?

3. How confident are JHS mathematics teachers in teaching algebra in the Akwapim-North Municipality?
4. What challenges confront JHS mathematics teachers in teaching algebra in the Akwapim-North Municipality?

Research Hypothesis

There is no statistically significant difference between teachers' years of experience and their confidence for teaching algebra in the Akwapim-North Municipality.

5.2 Findings

Four key findings were gathered:

1. The majority of JHS mathematics teachers (57.8%) in the Akwapim-North Municipality have a moderate level of content knowledge for teaching algebra. Their strength lies in teaching topics such as Patterns and Relationships, Algebraic Expressions, Variables, and Linear Equations, while they experience difficulties in teaching Quadratic Equations, Simultaneous Equations, Word Problems, and Inequalities.
2. The pedagogical approaches used by JHS mathematics teachers in teaching algebra in the Akwapim-North Municipality include group work, verbal explanation, class discussion, then demonstration using traditional resources like board, textbooks and past questions, bottle tops, sticks. The use of digital and visual aids was limited due to resource constraints.
3. JHS mathematics teachers in the Akwapim-North Municipality reported high confidence in teaching algebra, with particular strength in creating engaging lessons, identifying misconceptions, mentoring new teachers and getting motivated to teach algebra. Factors such as strong content knowledge, teaching

experience, positive learner feedback, and access to supportive resources and training influenced their confidence level.

4. JHS mathematics teachers in the Akwapim-North Municipality face several key challenges, such as difficulty in translating algebraic word problems into arithmetic forms, inadequate instructional resources, limited professional training, difficulties in representing algebraic tasks in word problems, and difficulties in expanding more than one term bracket, in teaching algebra. These challenges are attributed to factors such as a lack of prerequisite knowledge, resource constraints, and language barriers.
5. The study found no significant difference in teachers' confidence levels based on their years of teaching experience. Hence, the study failed to reject null hypothesis (H_0) and conclude that regardless of their years of experience, JHS mathematics teachers in the Akwapim-North Municipality exhibit similar levels of confidence in teaching algebra.

5.3 Conclusions

The following conclusion were drawn from the findings:

1. The findings suggest that while JHS mathematics teachers in the Akwapim-North Municipality have a moderate overall content knowledge for teaching algebra, there are gaps in specialized content knowledge. This may affect their ability to provide in-depth explanations and address students' misconceptions effectively, potentially influencing the quality of algebra instruction.
2. The reliance on traditional pedagogical approaches, such as verbal explanation, question-and-answer, and discussion, indicates that algebra instruction in the municipality is largely teacher-centered. The limited use of digital and visual

aids due to resource constraints may hinder opportunities for interactive and exploratory learning, which are essential for deep conceptual understanding.

3. The high confidence levels reported by JHS mathematics teachers in teaching algebra suggest a positive self-perception of their teaching abilities. This confidence, particularly in lesson engagement, misconception identification, and mentoring, may contribute to improved instructional delivery.
4. The challenges faced by JHS mathematics teachers highlight issues that may hinder effective algebra instruction. Difficulties in translating word problems, inadequate resources, and insufficient training suggest that students may struggle with algebraic concepts due to instructional limitations.
5. The lack of a significant difference in confidence levels based on teaching experience suggests that experience alone may not be a determining factor in self-confidence for teaching algebra. This implies that other factors, such as professional development opportunities, instructional support, and exposure to modern teaching strategies, may play a more critical role in shaping teachers' confidence in their instructional practices.

5.4 Recommendations

1. To enhance JHS mathematics teachers' specialized content knowledge in algebra, the Akwapim-North Municipal Education Directorate should focus their professional development workshops on deepening teachers' understanding of algebraic concepts like quadratic equations, simultaneous equations, word problems, and inequalities.
2. Since there is a limited use of digital resources among the teachers, schools and educational stakeholders in Akwapim-North Municipality should invest in providing digital and visual teaching aids, such as interactive software, videos,

and algebra manipulatives. Additionally, teachers should be trained on how to effectively integrate these resources into their instructional practices.

3. While teachers exhibit high confidence in teaching algebra, Heads of junior high schools and School Improvement Support Officers (SISOs) in Akwapim-North Municipality should monitor and encourage the teachers to engage in ongoing training and reflective practice to ensure their confidence translates into effective teaching.
4. To address the challenges faced by JHS mathematics teachers in teaching algebra, the Municipal Education Office should source for adequate instructional resources from NGOs, organize training workshops on algebraic problem-solving strategies, and incorporating language support programs to help teachers and students overcome language-related barriers in algebra instruction.
5. Since teaching experience alone does not significantly impact teachers' confidence in teaching algebra, the JHS mathematics teachers in Akwapim-North Municipality should consider other factors like seeking continuous professional training. These trainings in the form of workshops, refresher courses, and mentorship programs should be designed to equip teachers with innovative teaching strategies and up-to-date knowledge to improve their confidence and effectiveness in algebra instruction.

5.5 Suggestions for Future Studies

Future research could explore JHS mathematics teachers' knowledge for teaching various components of algebra, such as patterns and relations, algebraic expressions, and equations. This would provide deeper insights into their strengths and areas that require support.

Also, researchers could replicate this study at the upper primary level to examine how algebra is introduced and taught at an earlier stage. This would offer a more comprehensive understanding of algebra instruction across different educational levels within the municipality.

Again, since JHS mathematics teachers in the Akwapim-North Municipality reported high confidence in teaching algebra, future studies could investigate whether this confidence translates into improved student performance in algebra-related topics

Moreover, given that the study found no significant difference in teacher confidence based on experience, further studies could examine whether years of teaching influence their pedagogical approaches in algebra lessons.

Lastly, future studies could explore how demographic factors such as gender, academic qualifications, school location, and school type affect teachers' confidence levels in algebra. This could help identify specific factors that contribute to variations in teaching confidence and practice.

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APPENDIX A

QUESTIONNAIRE FOR TEACHERS

Dear Sir/Madam,

You are please being invited to participate in the survey titled, "**Teacher Knowledge for Teaching Algebra; The Case of JHS Mathematics Teachers in Akwapim - North Municipality of Ghana**".

Your participation in this study is completely voluntary. There are no foreseeable risks associated with this project. Your survey responses will be strictly confidential and data from this research will be used for research purposes only. Please take the time to read attentively each item on the questionnaire or statement and give the response best reflecting what you currently think.

SECTION A: Demographics of Respondents

Please, tick (√) in the box to reflect your current status.

1. **Gender**: (a) Male [ ] (b) Female [ ]

2. **Age**: (a) Less than 30 years [ ] (b) 30-39 years [ ]
   (c) 40-49 years [ ] (d) 50 & above [ ]

3. **Educational Qualification**: (a) Teacher's certificate 'A' [ ]
   (b) Diploma in education [ ] (c) First Degree (d) Masters [ ] (e) Ph.D [ ]

4. **Mathematics Teaching Experience** (a) Less than a year [ ] (b) 1- 5years [ ]

(c) 6 – 10 years [ ] (d). 11 – 15 years [ ] (e) 16-20yrs [ ] (f) 21years and above [ ]

SECTION B

PART I: Level of JHS Teachers' Content Knowledge of Algebra

This section seeks to identify the level of teacher content knowledge of algebra among JHS mathematics teachers in the Akwapim-North Municipality. Kindly provide responses to the following question on algebra in the space provided. (14mrks)

a) Common Content Knowledge (CCK)

1. Please solve these:

   a) $4^{2x-1} = \frac{1}{16}$

   b) What is the algebraic expression for the relation; 'a' is twice as much as 'b'

   c) If the square of a number minus 4 is equal to 21, what is the number?

b) Specialized content knowledge (SCK)

2. Use 2 different approaches to solve each of these;

   a) $x+10$

   i……

   ……

   ……

   ii……

   ……

   ……

   ……

   ……

b) 7 + y = 63

i……

……

……

……

ii……

……

……

……

……

c) Horizon content knowledge (HCK)

a) How is algebra applied in real life? Write two (2)

……

……

……

……

……

b) What topics are related to algebra? Write two (2)

……

……

……

……

……

PART II: JHS Teachers' Pedagogical Approaches in Teaching Algebra

1. Write down all the approaches or techniques you usually use when teaching algebra topics in your classroom?

   ……

   ……

   ……

   ……

   ……

2. State all the resources or materials you use to support your teaching of algebra?

   ……

   ……

   ……

   ……

   ……..

PART III: JHS Teachers' Confidence in Teaching Algebra

How would you rate your own self-efficacy in teaching algebra?

The attached form lists different activities. In the column 'Confidence' rate how confident you are that you can do them as of now. Rate your degree of confidence by recording a number from 0 to 10 using the scale below.

0 1 2 3 4 5 6 7 8 9 10

Cannot Do at all — Moderately Certain can do — Certain Can do

S/N	How much confidence do you have in your …?	Confidence
	Performance Accomplishment	
1.	Ability to effectively teach and help your learners succeed in solving questions on algebra?	
2.	Ability to create lessons that actively engage your learners and maintain their interest in learning algebra?	
3.	Ability to design assessments that accurately measure learners' understanding of algebra?	
4.	Ability to identify learners' challenges and misconceptions in algebra and provide effective solutions?	
	Vicarious Experience	
5.	Ability to mentor and support newer teachers in teaching algebra?	
6.	Ability to get motivated to try new approaches to teaching algebra?	
	Verbal Persuasion	
7.	Ability to be motivated upon colleagues' constructive feedback and praise of your lesson on algebra?	
8.	Ability to be motivated upon mentor's/supervisor's words of encouragement and recognition of your lesson on algebra?	
	Physiological Information	
9.	Ability to manage stress and maintain composure, in handling challenging aspects of algebra?	
10.	High energy levels and can adjust teaching approach to ensure learner engagement during lessons on algebra?	
TOTAL:		

PART IV: CHALLENGES IN TEACHING ALGEBRA

The following statements seeks to identify the challenges JHS mathematics teachers face in teaching algebra in the Akwapim-North Municipality. Carefully read each statement and rate it as accurately as possible. Circle (◌) a number that best describes your view on each of the items. **On a scale of 1-4**, **rate your views as follows:** Strongly Disagree (SD) = 1, Disagree (D) = 2, Agree (A) = 3, and Strongly Agree (SA) = 4.

S/n	Statement (**Challenges in teaching algebra)**	**SD**	**D**	**A**	**SA**
1	Difficulty relating algebraic concepts to everyday life of learners.	1	2	3	4
2	Difficulty getting instructional resources on algebraic topics.	1	2	3	4
3	Lack of adequate in-service training programmes organized on teaching algebra in my district.	1	2	3	4
4	Difficulty in factorizing difference of two squares.	1	2	3	4
5	Difficulty in expanding more than one term bracket.	1	2	3	4
6	Difficulty in expanding more than one term exponential equations.	1	2	3	4
7	Difficulty in applying the laws of indices.	1	2	3	4
8	Difficulty in applying PEDMAS/BODMAS rule for order of operations.	1	2	3	4
9	Difficulty in representing algebraic task in word problems.	1	2	3	4
10	Difficulty in translating algebraic word problems to arithmetic forms.	1	2	3	4

THE END

APPENDIX B

INTERVIEW PROTOCOL FOR TEACHERS

TOPIC: Teacher Knowledge for Teaching Algebra: The Case of JHS Mathematics Teachers in Akwapim -North Municipality of Ghana.

Introduction: Hello, thank you for agreeing to take part in this interview. This interview is to explore the content knowledge, pedagogical approaches, self-efficacy, and challenges faced by JHS mathematics teachers in teaching algebra in the Akwapim-North Municipality. Please note that your responses will be kept confidential and used solely for research purposes. With your permission, I would like to record this interview for accurate data collection. Is that okay with you?

SECTION A: Personal Information

1. Please, what is your highest level of academic qualifications?
2. How long have you been teaching mathematics, and specifically, algebra?

SECTION B

Part 1: JHS Teachers' Content Knowledge for Teaching Algebra

1. Which topics in the junior high school algebra syllabus do you feel you have more knowledge about and can teach it effectively?
2. Why do feel more knowledgeable teaching these topics?
3. Which algebra topics do you find most difficult to teach?
4. What makes these topics particularly challenging for you or your students?

Part 2: JHS Teachers' Pedagogical Approaches in Teaching Algebra

1. What teaching strategies do you use to help students to understand algebra topics. Please, explain how you do this?
2. What instructional resources do you use in teaching the various topics in algebra? Please, explain how you do this?
3. How do you integrate technology or other educational resources into your teaching of algebra in class?

Part 3: JHS Teachers' Self-Confidence in Teaching Algebra

1. Can you describe your confident level when teaching different algebra topics?
2. What helps you feel confident?

Part 4: JHS Teachers' Challenges in Teaching Algebra

1. What are challenges do you face when teaching algebra in your class?
2. What factors account for these challenges?

Conclusion: Thank you very much for your time and insights. Your contribution is greatly appreciated. May God bless you.

APPENDIX C

LETTER OF INTRODUCTION: DEPARTMENT OF BASIC EDUCATION

UNIVERSITY OF EDUCATION, WINNEBA
SCHOOL OF EDUCATION AND LIFE-LONG LEARNING
DEPARTMENT OF BASIC EDUCATION
P. O. Box 25, Winneba, Ghana
+233 (050) 9212015

Our ref: SELLL/DBE/ S.9/VOL.1/75 August 7, 2025

The Director,
Ghana Education Service,
Akwapim North Municipality,
Eastern Region.

Dear Sir/Madam,

LETTER OF INTRODUCTION

I write to introduce **Miss Rachael Simmons,** a second year M.Phil. student of the Department of Basic Education, University of Education, Winneba, with registration number **200023539.**

Miss Simmons is to carry out a research on the Topic: ***"Teacher Knowledge for Teaching Algebra: The case of JHS Mathematics Teachers in Akwapim North Municipality of Ghana."***

We would be grateful if she could be given the needed assistance to carry out her studies in your institution.

Thank you.

DEPT. OF BASIC EDUCATION
UNIVERSITY OF EDUCATION
WINNEBA, GHANA

PROF. MRS. SAKINA ACQUAH (PHD)
HEAD OF DEPARTMENT

APPENDIX D

LETTER OF APPROVAL: AKWAPIM-NORTH MUNICIPAL EDUCATION OFFICE

GHANA EDUCATION SERVICE

In case of reply the number and date
of this letter should be quoted.
My Ref.No: GES/ER/ANMO/MC: 1070/32
Your Ref. No.:.....

REPUBLIC OF GHANA

MUNICIPAL EDUCATION OFFICE
POST OFFICE BOX 102
AKROPONG – AKUAPEM NORTH

11th APRIL, 2024

LETTER OF INTRODUCTION

Permission has been granted to Miss Rachael Simmons, a teacher in Akuapem-North Municipality and an M.Phil. student of the Department of Basic Education, University of Education, Winneba to conduct research in Akuapem-North Municipality from July to September, 2024.

Miss Rachael Simmons is carrying out research on the topic: **"Teacher knowledge for teaching algebra: the case of JHS Mathematics Teachers in Akuapem-North Municipality of Ghana"**.

You are to ensure that your research does not interrupt teaching and learning in the schools.

Headteachers are to assist the researcher to gather the relevant data for her thesis.

Thank You

NICHOLAS KWAKU DARKO
DEPUTY DIRECTOR, SUPERVISION AND MONITORING
FOR: MUNICIPAL DIRECTOR

DEPUTY DIRECTOR
SUPERVISON & MONITORY
GHANA EDUCATION SERVICE
AKUAPEM NORTH
AKROPONG AKUAPEM