**CHAPTER ONE**

**THE PROBLEM**

**1.1** **Introduction**

Mathematics education in Nigeria especially at the secondary school level has incessantly called for the attention of all and sundry. This is because the lofty efforts of virtually all the Nigerian educational bodies involved in the curriculum planning and implementations as well as mathematics educators and teachers to improve and promote effective mathematics teaching and learning at both primary and secondary school levels have not yet been commended. The performances of our secondary school students in both internal and external examinations of the West Africa Examinations Council (WAEC) and National Examinations Council (NECO) serve as genuine evidence to the above averments. Unfortunately, it is known to everyone as reported by Okafor, (2005) that no nation can develop scientifically and technologically without a proper foundation in school mathematics. Frankly speaking, the relevance of mathematics is not only restricted to science and technologybut its usefulness is also felt and demanded in almost all important modern professions including Historians, Political Analysts and Strategists, Seamstresses, Physicians, Educators, Forest Rangers, Fabric Designers, Consumer Advocates, Traffic Accident Reconstructionist, Crime Scene Investigators and so on. Even as observed by Steen, (2010) our economy, democracy, national defense, social security, disaster relief operators as well as political campaigns, and voting all depend on mathematical models and quantitative habits of mind.

Nigeria's Educational System recognized all the aforementioned values of mathematics and as a result of that, the subject is made compulsory at both primary and secondary levels of education (Federal Republic of Nigeria, 2004). It is also a compulsory subject for entry requirement into the university education. The general mathematics syllabus is specifically designed to equip the students with the understanding of mathematical concepts, ideas, theorems, basic assumptions logical structures, abstract symbolism, and their wide applications to everyday lifestyle (Obagaiye, 2013). These goals necessitate that the teaching and learning of mathematics need to be handled solemnly and a special priority should be given to it.

Recently, the Nigerian Educational Research and Development Council (2007) has developed the new teaching syllabus as well as a teachers' guide for mathematics at the primary and junior secondary school levels which is additional support to the number of existing projects executed by the National Mathematical Centre (NMC), Mathematical Association of Nigeria (MAN) and others to promote effective mathematical teaching at all levels of educations in Nigeria. Nevertheless, all these strivings have not made any remarkable success in the students’ academic performance in Mathematics. Studies and WAEC reports reviewed that Nigerian students' performances in mathematics at the senior secondary school examinations (SSCE) have been relatively low (Agwagah, 2000; Obodo, 2004; Harbor-Peter &Iji, 2005; Gimba, 2006; Kurumeh, 2006; Osenwinyen, 2009; WAEC, 2006; 2007; 2008; 2009; 2010; 2011; 2012);NECO, 2012; Iwendi, 2012.

Many reasons have been attributed to have contributed to this ugly situation and various attempts have been made to address the situation. One of the most persistent and compelling factors besetting students' achievement in Nigeria as confirmed byOkeke (2001)andOkafor (2002)is the poor quality of teaching. It has been reported that in Nigerian mathematics classrooms, the most common instructional method of teaching is the lecture method (Suleiman,Gamkgiwa&Ademola, 2007). The method according to Bashir (2007) and Dauda (2007) is ineffective, unsuitable, and unproductive to the teaching and learning of mathematics. The method is marked by the predomination of teacher's discussions with no active involvement of students in the learning process. Even lessons that require manipulative objects are taught on the chalkboard. The method has no potential for meaningful learning. Hence, the purpose of this study is to find out better alternative method over the existing lecture method.

According to Gambari,Falode, and Adegbenro (2003), an effective instructional method employed by the teacher plays an important role in the acquisition of skill and meaningful learning. The contextual teaching strategy is identified as a promising strategy that actively engages students and promotes learning and skills development (Center for Student Success, 2007). The strategy is drawn from established and growing bodies of research that include theories and writings by John Dewey, Jean Piaget, Bruner, Lev Vygotsky, and others called constructivism. It is defined by Mazzeo (2008) as a diverse family of instructional strategies designed to more seamlessly link the learning of foundational skills and academic or occupational content by focusing teaching and learning squarely on concrete applications in a specific context that is of interest to the student.

The study investigated the effect of teaching algebraic concepts using the contextual strategy on two key variables: attitudes and performance. Attitude is viewed by many researchers as a key driver of higher or lower performance in mathematics (Mohamed &Waheed, 2011; Mata, Monteiro&Peixoto, 2012; Ngussa&Mbuti, 2017). According to Sarmah and Puri (2014), attitude is a learned tendency for a person to respond positively or negatively to an object, a situation, a concept, or another person. For Obodo (2005), attitude is regarded as a favorable or an unfavorable reaction towards some experiences, situations, or activities as a result of the way such an individual perceives and conceptualizes them. Thus, a question like of what importance is the concept of a quadratic equation to my life can be considered as a response of a person's attitude towards the learning of quadratic equation. It was argued that attitudes may change and grow over time (Syyeda, 2016), and once a positive attitude is created, it may enhance student learning (Akinsola&Olowojaiye, 2008; Mutai, 2011). On the other hand, a negative attitude hinders effective learning and thus affects the outcome of learning when performance is involved (Joseph, 2013). Therefore, attitude is a fundamental consideration that must not be overlooked. Its effect on students’ performance in mathematics may be positive or negative depending on the individual student.The main challenge here, according to Salman (2004), is that most mathematics teachers do not make mathematics teaching hands-on and exciting. Thus, this kind of instruction leads to a negative attitude towards mathematics by students and in turn, cripples their performance.

Performance according to Park and Oliver (2007) is an observable or measurable behavior of an individual or animal in a particular situation, usually an experimental situation. The performance of a student was defined by Nneji (2013) as the gain in knowledge of students as a result of taking part in a learning activity or program. It is therefore not inappropriate to describe it as evidence demonstrating the outcomes of a person's learning. Adedeji (2000) explained that student performance is very important because it seems to be the primary measure of the effectiveness and success of any educational institution. Research evidence has shown that poor mathematical performance is due to teachers not using appropriate pedagogical approaches (Harbor-Peters, 2001).Consequently, the issue of poor academic performance of students in mathematics could be viewed from a perspective due to the strategies employed by teachers rather than looking at students as the causes. From this point of view, the study sought to determine whether the contextual teaching strategy is a constructive teaching strategy that could solve the problem of poor performance of students and their negative attitude towards algebraic concepts, irrespective of gender so that it can be adopted in place of the predominant lecture method.

**1.2** **Statement of Problem**

There have been a lot of studies in the teaching of school algebra in the last 20 years. Despite all the studies, there is no remarkable success in the academic performance and attitudes of students in algebraic concepts as reported by Galadima (2007). Corroborating this report, the WAEC Chief Examiner (2012), declared that the majority of the candidates displayed weaknesses in algebraic processes and that their performances were very low.The trend of performances in mathematics among senior secondary school students inWAEC, in Nigeria was abysmal. For instance,the analysis of students’performances in general mathematics in the May\June West Africa African Examination Council (WAEC) in Nigeria between the years 1991 to 2016, precisely twenty six (26) years ago, indicated that the the percentage of students who obtained credit and above credits above was 27.31% (WAEC, 2017).By implication, one of reasons for students’ low performances in mathematics is due to their lack of algebraic skills. Thus,students need more algebraic frameworks to develop their mathematical problem-solving skills and as well to enable them to perform better in mathematics.This students’ crucial need cannot be achieved

The proposed instructional method for this study is contextual teaching strategy. The strategy is an instructional method that focuses on the multiple aspects of any learning environment such as classroom, laboratory, computer lab, and worksite. Research findingsalso showed that it has a potential for improving the academicperformance of studentsandit is a highly effective means of accommodating students’ different learning styles because an instructor can utilize several divergent instructional models within the contextual framework including collaborative pairs, hands-on demonstration, and inquiry groups. Consequently, this research seeks to investigate the effect of Contextual Teaching Strategy on Attitude and Performance in Algebraamong Senior Secondary School Students in Zaria metropolis, Kaduna State, Nigeria.

**1.3 Objectives of the study**

Thisresearch aimed at investigating the effect of Contextual Teaching Strategy on Attitude and Performance in Algebraamong Senior Secondary School Students in Zaria metropolis, Kaduna State, Nigeria. Specifically, the study sought to:

1. verify the effect of contextual teaching strategy on students’ performanceinalgebraic concepts at senior secondary school.
2. investigate the effect of contextual teaching strategy on students’ attitudes towards algebraic concepts atsenior secondary school.
3. find out whether contextual teaching strategy has effects on the performanceof male and female students in algebraic concepts.
4. verify whether contextual teaching strategy affects gender on students’ attitudinal change towards algebraic concepts.

**1.4 Research Questions**

To achieve the objectives of the study, the following research questions wereposed to guide the conduct of the study:

1. Is there any difference between the mean performance of the students taught algebraic concepts with contextual teaching strategy and those taught with lecture method?
2. Is there anydifference between the attitudes levelof students taught algebraic conceptswith contextual teaching strategy and those taught with lecture method?
3. What is thedifference betweenthe mean performance of male and female students taught algebraic concepts with contextual teaching strategy?
4. What is the difference between the attitudes of male and female students taught algebraic concepts with contextual teaching strategy?

**1.5 Null Hypotheses**

The following null hypotheses were tested at 0.05 levels of significance:

Ho1 There is no significant difference between the mean performanceof students taught algebraic concepts with contextual teaching strategy and those taught with lecture method.

Ho2 There is no significant difference between the attitudes level of students taught algebraic concepts with contextual teaching strategyand those taught with lecture method.

Ho3 There is no significant difference between the mean performance of male and female students taught algebraic concepts with contextual teaching strategy.

Ho4 There is no significant difference between the attitude level of male and female students taught algebraic concepts with contextual teaching strategy

**1.6 Significance of the study**

This study was significant in the following ways:students would benefit more because they would take the advantage of learning algebra concepts within a social and concrete, memorable context; they would be actively engaged and concentrated in the learning processes and activities with the teacher facilitating theirplanning, self-evaluation, and self-monitoring skills; their varying difference will be adequately considered through their exposure to many divergent instructional models within the contextual framework such as collaborative pairs, in-class visual and hand-on demonstration, inquiry group, group interaction among others and in addition; they would benefit from the significant activities contained within the instructional package such as solving real-world problems, transferring of knowledge in a new context, creating graphs, preparing projects, engaging in hands-on problem-solving activities, conducting quizzes and so on. Thus, the students, irrespective of their learning styles, will hopefully gain mastery of algebra concepts in particular and mathematics in general when exposed to the strategy as reflected in the study.

The study anticipated offering mathematics teachers a good hand for adopting and implementing the strategy in the classroom by providing instruction and guidance on how it can be fully practiced in secondary schools. It is believed that the strategy employed in this study will enlighten the subject teacher on how to set up a mathematics classroom that uses different forms of meaningful experiences and multiple aspects of the learning environment leading to better output in terms of performance. It is also hoped that the result of this study would be a solution to the present poor performance of students in our standardized examinations.

Curriculum planners could find this study useful in the designing of a system of instruction that actively engages students, connect mathematical concepts to a real-life situation and promote learning and skills development. Hence, the study gave planners information on how this kind of instruction could be structured. It is hoped that professional research bodies and organizations such as the Mathematical Association of Nigeria (MAN), Science Teachers Association of Nigerian (STAN), Nigerian Education Research and Department Council (NERDC), and others will find this study useful in their contributions to the development and implementation of the Nigerian mathematics curriculum. It is also expected that the findings of this study would add to the existing works of literature for mathematics and science-based researchers, stimulate future studies and pave the way for the use of contextual instructional strategy in other fields of study.

Textbook publishers can also use the findings in their books as a sound approach to teaching algebra at the junior and senior secondary schools by applying the contextual teaching strategy steps in the designing of algebra contents in both teachers and students’ copies to minimize its abstractness and thus facilitate learning processes as well as expand their business opportunities.

**1.7 Basic Assumptions**

The research work was guided by the following assumptions:

1. All the students involved in the study have learned basic algebraic concepts from their JSS and SSS1 mathematics curriculum which are worthwhile for the present study.
2. All sampled studentsin the experimental group are participating in the learning activities with no prior experienced contextual teaching experience.
3. All sampled schools represented the population of the study.

**1.8** **Scope/Delimitation of the study**

The study investigated the effect of contextual teaching strategy on attitude and performance in algebra among senior secondary school students in the metropolis of Zaria, Kaduna, Nigeria. Zaria is a large city within the State of Kaduna, Nigeria. It has a zonal educational office consisting of forty-nine (49) public secondary schools and one hundred and thirty-four (134) private secondary schools. The target population for this study was all government (public) senior secondary schools, two (SSII) within the Kaduna State Teachers Service Board areas.

The sample used was limited to two co-educational senior secondary schools (SSII) and the choice of using co-educational schools was because the study examined gender variability. SSII students were chosen asthe algebraic concepts covered by the study were taught at their level. In this quasi-experimental study, one of the sampled schools was randomly assigned as an experimental school and the other as a control school. The study used contextual teaching strategy (CTS) as a method to teach algebraic concepts in the experimental group, and its counterpart was taught the same algebraic concepts using the traditional method.

The study's subject areas were drawn from the SSII Mathematics syllabus, and restricted to the following algebraic processes: algebraic expansions, factorization of quadratic expressions – perfect squares and difference of two squares, making quadratic expressions perfect squares, solving algebraic equations by factorization, completing the square, and using a formula, solving equations with irrational roots and solving word problem leading to algebraic equations.

**CHAPTER TWO**

**REVIEW OF RELATED LITERATURE**

**2.1 Introduction**

In this chapter obtainable and pertinent works of literature were reviewed and discussed under the following sub-headings.

2.2 Theoretical Framework

2.3 Conceptual Framework for the study

2.3.1 The Concept of Contextual Teaching Strategy

2.3.2 Contextual Teaching Strategy

2.4 Concept of Algebra

2.5 Concept of Academic Performance in Algebra

2.6 Concept of Students’ Attitude towards Algebra

2.7 Students’ Attitude and Academic Performance in Algebra

2.8 Overview of Similar Studies

2.9 Implication of Literature Reviewed to the Study

**2.2 Theoretical Framework**

Contextual teaching strategy is a proven strategy that incorporates much of the most recent research in cognitive science (Hull, 2000). It is a reaction to the behaviorist theories, a traditional approach to education, where students receive direct instruction and then practice specific skills (Berns& Erickson, 2001). From a cognitive learning perspective, learning involves the transformation of information in the environment into knowledge that is stored in the mind. Contextual teaching theory matches this perspective as its emphasis is that learning occurs only when students process new information or knowledge in such a way that it makes sense to them in their frame of reference (their inner worlds of memory, experience, and response) (CORD, 2001). Building upon this understanding, contextual teaching theory focuses on the multiple aspects of any learning environment. It encourages educators to choose and/or design learning environments that incorporate as many different forms of experience as possible—social, cultural, physical, and psychological—in working toward the desired learning outcomes (ibid).

The strategy is drawn from established and growing bodies of research that include theories and writings by John Dewey, Jean Piaget, Bruner, Lev Vygotsky, and others called constructivism (Crawford, 2001). The term constructivism is broadly conceived by many researchers as the theory which emphasizes is that each constructs knowledge rather than receiving it from others (Phillip, 2001). According to constructivist learning theory, individuals learn by constructing meaning through interacting with and interpreting their environments (Brown 2000). To be specific, Dirkx, Amey,andHaston, (2000) argued that the meaning of what individuals learn is coupled with their life experiences and contexts; it is constructed by the learners, not by the teachers; and learning is anchored in the context of real-life situations and problems. Based onPiaget's (1970) theoryofknowledge,the constructionofknowledgeisaprocessofinteractionbetweentheindividualandtheenvironment. Hemaintainedthatasindividualsinteract with the environment, inmate mental structures are recognized as gaps and contradictions are modified which in turn trigger the process of assimilation and accommodation. Thus, through accommodation, the new and meaningful information is constructed by the individual and assimilated into a new cognitive system. Accordingly, the theory is an existing structure that asserted that learners are to be actively involved in the learning process by using a variety of cognitive processes and incessantly updating their memory based on ongoing experience. The major cognitive processes according to Mayer (2000) include paying attention to relevant information, organizing that information into coherent representations, and integrating the representations with existing knowledge.

In another development, Dirkx, Amey, and Haston (2000) stated that constructivism challenges the technical-rational approach to education by redefining the relationship between the knower and what is known, including what is most worth knowing and who decides. Thus, the knower and the known should be interdependent and co-created during the inquiry process (Krauss (2005), cited in lee & Yee-Sakamoto, 2012). In the same vein, Hope and Karandjeff (2009), stated that the measure of and motivation for learning, in the constructivist framework rests with the learner, not the instructor. They stressed that the instructor’s primary responsibility is to create conditions that support student engagement in the learning process.

Rooted in constructivist theory, contextual teaching strategy is an approach that emphasizes the learning process through “constructing” not memorizing (Mayasari&Herawati, 2012) and it does so by focusing teaching and learning squarely using scenarios from the lives of students outside of the classroom or on concrete applications in a specific context that is of interest to the students (Gilbert, 2006; Mazzeo, 2008). According to Tambelu, (2013), contextual teaching strategy is a conception that: helps teachers connect content learning materials with real situations and motivates students to make connections between knowledge and its application to their lives as family members, citizens, and laborers; assumes thatlearning that takes place in a close relationship with experience; assumes learning only occurs when students process new information or knowledge in such a way that they seem reasonable and accordance with the frame of mind that is owned (memories, experiences, and responses). Because contextual teaching strategy maintains that learning is a process of constructing meaning from experience, its conception is congruent with the constructivist learning theory.

However, a literature review also indicates that contextual teaching strategy is grounded in a range of inter-related theories about how people learn (Baker, Hope &Karandjeff, 2009). These include research on motivation theory, problem-based learning, social cognitive theory, and learning styles (ibid). While each is distinct in focus, these theories combine to underscore contextual teaching strategy as a means for advancing student success by increasing interest and motivation, heightening the utility of skills and information, enhancing connectivity to peers, and accommodating diverse ways of learning (ibid). Moreover, recent breakthroughs in brain research indicate that contextual teaching strategy can stimulate a student’s brain to develop patterns and create meaning by linking experience and sensory stimuli to new knowledge through a real-life application( Zull, 2012).

More contemporary work which serves as the base for contextual teaching strategy included syntheses by Resnick and Hall (2000) and themes identified by Borko and Putnam (2001). These according to Robert and Patricia (2001) are:

1. Knowledge-based constructivism: Both direct instruction and constructivist activities can be compatible and effective in the achievement of learning goals (Resnick& Hall 2000).
2. Incremental theory of intelligence. Increasing one’s efforts results in more ability. This theory opposes the notion that one’s aptitude is unchangeable. Striving for learning goals motivates an individual to be engaged in activities with a commitment to learning (ibid.).
3. Socialization: Children learn the standards, values, and knowledge of society by raising questions and accepting challenges to find solutions that are not immediately apparent, along with explaining concepts, justifying their reasoning, and seeking information (ibid.). Indeed, learning is a social process, requiring social and cultural factors to be considered during instructional planning. This social nature of learning also drives the determination of the learning goals (Borko& Putnam 2001).
4. Situated learning: Knowledge and learning are situated in particular physical and social contexts. A range of settings may be used such as the home, the community, and the workplace, depending on the purpose of instruction and the intended learning goals (ibid.).
5. Distributed learning: Knowledge may be viewed as distributed or stretched over (Lave 2000) the individual, other persons, and various artifacts such as physical and symbolic tools (Salomon 2000) and not solely as a property of individuals. Thus, people, as an integral part of the learning process, must share knowledge and tasks (Borko& Putnam 2001).

According to Berns and Erickson (2001), these theories and others serve as underlying principles upon which the Contextual Teaching conception and process are based. Indeed, the contextual teaching strategy recognizes that learning is a complex and multifaceted process that goes far beyond drill-oriented, stimulus-and-response methodologies (Center for Occupational Research and Development, 2001).

**2.3** **Conceptual Framework for the study**

With the aforementioned theories as support, a growing number of researchers and practitioners increasingly agreethat contextual teaching strategy has a positive impact on the learning experience. Contextual teaching strategy advocates believe that through the strategy, learners can understand specific ideas or concepts, develop the ability to engage this information in action, understand the relationships between the knowledge learned, and the capacity tounderstand one’s self or others), to mention a few (Baker, Hope &Karandjeff, 2009).

This study is guided by some conceptual perceptions: firstly, contextual teaching strategy has a positive impact on students' attitudes. The study of Richard Lynch (2000), a professor of occupational studies and the principal investigator of the University of Georgia reviewed that 94% of the students said that they learned a lot more in contextual teaching strategy classes than in traditional courses in that same subject area (Predmore, 2005). Similarly,RubiniandPermanasari (2014) carried out research aiming at finding the effect of the developed model of contextual teaching strategy of basic science coursesin enhancing non-science students’ scientific literacy in the mastery of concepts, context, process skill, and attitudes of students towards science. The overall subjects of the research were 86 accounting students. The research reveals that the use of the model gave implication to the increasing of scientific literacy of accounting students, in the aspect of mastery of concepts, as well as on the application concept into context, process skill, and students' attitudes toward science. Specifically, it reveals that 96% of the participants said that a basic science course is needed, while 90% also said that the course is required for the development of scientific thinking skills. These could be because of the lecture that is started by showing facts or natural events such as earthquakes in various places, blasting various places by using a powerful bomb, as well as other phenomena as explained in their work. A study utilizing contextual teaching strategy indicated that as a result of their experiences more than 80% of the participants expressed that they were able to think more deeply about the topics and were able to participate more actively in the learning (Choo, 2007). It has also been pointed out by Kamaruddin and Amin (2009) that contextual teaching strategy is a system of instruction that allows students to find meaning in their lessons because it connects the new lesson to the real world. In turn, this enhances their attitude towards learning.

Secondly, contextual teaching strategy improves students' academic performance in algebra.A summative analysis of Elementary Algebra (Math 25) performed by the Los Medanos College's Mathematics Department in 2007, reviewed that the students of instructors who used contextual teaching strategy show a significant increase in performance over those that were not taught with the strategy.Similarly, the study of Mtsem (2011) on the effects of diagnostic and contextual teaching strategy on students’ interest and performance in Secondary school Algebra concluded that contextual teaching strategy had positive effects on students’ academic performance. In this study, an investigation will be carried out on the effect of contextual teaching strategy on academic performance and attitude of secondary school students towards algebra.

**2.3.1** **Concept of Contextual Teaching Strategy**

Psychology suggests that individuals learn by constructing meaning through interacting with and interpreting their environments (Brown, 2000). Contextual teaching theory recognizes this human need and seeks to promote teaching and learning which connects new information to what is already known and places it in the individual’s relevant environments or frames of reference whether they be memory, experience, or response (Center for Occupational Research and Development, 2000).It is an approach to teaching that assumes the mind naturally seeks meaning in a context that is, concerning the person’s current environment and that, it does so by searching for relationships that make sense and appear useful (Center for Occupational Research and Development, 2001). ‘Connecting content with context is an important part of bringing meaning to the learning process’ (Wilson, 2001). According to Johnson (2002), ‘context gives meaning to content’. This is why; it is termed as a system that ties brain actions to crating patterns that have meaning (Davtyan, 2014). According to Johnson, Berg & Donaldson, (2005), students find meaning in their schoolwork when they join the content of academic subjects with the context of daily life. So connecting academic subjects to an authentic context goes a long way in helping the students find and create meaning through experience, drawing from prior knowledge to build upon existing knowledge (Baker, Hope &Karandjeff, 2009).

In contextual teaching strategy, experiences help students make connections with both internal and external contexts. According to Berns and Erickson (2001), students begin with their existing knowledge, past experiences, and other current classes or situations and conduct activities in such external contexts as the school, home, workplace, and the Internet. Such experiences result in a deeper understanding so that students are more likely to retain competencies for a longer period and be able to apply them in appropriate ways at appropriate times in the future. Thus, as stated by Berns and Erickson (2001), contextual teaching strategy is based on developing new skills, knowledge, abilities, and attitudes in students by presenting new subject matter in meaningful and relevant contexts: contexts of previous experience, real-life, or the workplace. Students then find meaning in the learning process. One important feature of contextual teaching strategy as claimed by Carrigan (2008) is that it is a kind of instruction that engages active learning as a replacement for passive, traditional methods, through a variety of in-class visual and hands-on experiences which include the use of manipulative, problem-solving activities, and laboratories; collaborative pairs; high-level approaches among others.

Contextual teaching strategy has been defined in different ways, based on the intent of the group championing its use. According to Karweit (2001),contextual teaching strategy is a teaching strategy that is designed to support students in activities and problem-solving in ways that reflect the real-world nature of such tasks.Berns and Erickson (2001) stipulated that contextual teaching strategy is a strategy that involves students connecting the content with the context in which that content could be used. Crawford (2001) sees contextual teaching strategy as a successful technique that allows for deep understanding and allows students to reflect on the application of theoretical coursework to a real-world issue, problem, or situation relative to their own lives.Most recently, the United States Department of Education Office of Vocational and Adult Education (2001) characterized the strategy as a ‘conception of teaching and learning that helps teachers relate subject matter content to real-world situations’ (Berns& Erickson, 2001). Mazzeo (2008) broadened the definition, describing contextual teaching strategy as a ‘diverse family of instructional strategies designed to more seamlessly link the learning of foundational skills and academic or occupational content by focusing teaching and learning squarely on concrete applications in a specific context that is of interest to the student’. In the same light,Hudson and Whisler (2014) defined contextual teaching strategy as a way to introduce content using a variety of active learning techniques designed to help students connect what they already know to what they are expected to learn and to construct new knowledge from the analysis and synthesis of this learning process.

Contextual teaching strategyis application-oriented within the cases using scenarios from the lives of students outside of the classroom as described by Gilbert (2006); hence the application of this strategy helps students to acquire knowledge rather than to memorize facts. Additionally, the strategy helps to contribute to students’ lives or the lives of others around the world and helps them to acquire a better understanding of the natural environment (Bennett &Lubben, 2006; U¨ltay and U¨ ltay, 2012). Thus, participants can answer the question: ‘Why do I need to learn this?’ and context-based subjects can respond to this by linking theoretical knowledge with the real world. Bennett et al., (2005) stressed that in a context-based subject, contexts are the starting points for the development of its understanding, while the term context in an educational setting according toBransford, Brown, and Cocking (2000) refers to the following:

1. Learner-centered environments: the term “learner-centered” refers to environments that paycareful attention to the knowledge, skills, attitudes, and beliefs that learnersbring to the educational setting. This term according to Ladson-Billings (2000)includes teaching practices thathave been called “culturally responsive,” “culturally appropriate,” “culturallycompatible,” and “culturally relevant”.The term alsofits the concept of teachingattempting todiscover what students think about the problems on hand, discussingtheir misconceptions sensitively, and giving them situations to go on thinkingabout which will enable them to readjust their ideas (ibid). Overall, learner-centered environments include teachers who are awarethat learners construct their meanings, beginning with the beliefs, understandings,and cultural practices they bring to the classroom(Bransford, Brown & Cocking, 2000).
2. Knowledge-centered environments: Bransford, Brown, and Cocking (2000) pointed out that solely learner-centered environments would not necessarily help students acquire the knowledge and skills necessary to function effectively in society but the ability of an expert to think and solve problems requires well-organized bodies of knowledge that support planning and strategic thinking. Thus, knowledge-centered environments focus on the kinds of information and activities that help students develop an understanding of disciplines (Prawatet al, 2000). It takes seriously the need to help students become knowledgeable, by learning in ways that lead to understanding and subsequent transfer (ibid). It also encourages sense-making by making emphasis on new teaching approaches that support learning with understanding(Schoenfeld, 1999). The ones that begin with the informal ideas that students bring to school and gradually help them see how these ideas can be transformed and formalized(Cobb et al., 1992). In brevity, knowledge-centered environments intersect with learner-centered environments when instruction begins with a concern for students’ initial preconceptions about the subject matter.
3. Assessment-centered environments: Bransford, Brown, and Cocking, (2000) also pointedout that in addition to being learner-centered and knowledge-centered, effectivelydesigned learning environments must also be assessment-centered.The key principles of assessment are that they should provide opportunitiesfor feedback and revision and that what is assessed must be congruent withone’s learning goals. In other words, the two major uses of assessment are: The first, formative assessment, involves the use of assessments (usuallyadministered in the context of the classroom) as sources of feedback toimprove teaching and learning. Examples of formative assessments include teachers’ comments onwork in progress, such as drafts of papers or preparations for presentations.The second, summative assessment, measureswhat students have learned at the end of some set of learning activities.Examples of summative assessments include teacher-made tests given at theend of a unit of study and state and national achievement tests that studentstake at the end of a year (ibid).
4. Community-centered environments: The term community-centered refers to several aspects of a community, including the classroom as a community, the school as a community, and the degree to which students, teachers,and administers feel connected to the larger community of homes, businesses,states, the nation, and even the world. This is to say that the learning environment should promote a sense of community; classroom norms should encourage students to learn from one another and support one another’s improvement and learning in school should be connected with outside learning activities. Putting together all the four key components makes up what we referred to as a contextualized learning environment(Bransford,Brown & Cocking, 2000).Figure 2.1 illustrates the perspective on the contextualized learning environment.

Community

Learnercentered

Knowledge centered

Assessment centered

**Figure 2.1:** Perspective on the learning environment**.**

**Source:**Bransford,Brown and Cocking (2000).

The Center for Occupational Research and Development, (2000) pointed out that in any contextualized learning environment, students discover meaningful relationships between abstract ideas and practical applications in the context of the real world, and concepts are internalized through the process of discovering, reinforcing, and relating. It is also worthy of note that the primary principle of contextual teaching strategy as stated by Crawford (2001) is that knowledge becomes the students’ own when it is learned within the framework of an authentic context. An authentic context or situation according to Svinicki (2004) is defined in this way: ‘an authentic situation is similar to the situation in which the skills will be used eventually, or it can be a real-life situation in which the skills are needed but not necessarily representative of the learners’ future use of them’. Besides that, learning that takes place within authentic situations is also more likely to engage the student as a participant rather than an observer (lynch, 2000). In the traditional classroom, students often struggle to connect with abstractions. However, an authentic context helps the learner see the relevance of information and creates a pathway for them to understand the material (Baker, Hope &Karandjeff, 2009).

Drawing on its roots in constructivist learning theory, contextual teaching strategy has been characterized by different scholars. According toClifford & Wilson (2000), contextual teaching strategy has the following features:

1. Emphasizes problem-solving
2. Recognizes that teaching and learning need to occur in multiple contexts
3. Assists students in learning how to monitor their learning so that they can become self-regulated learners
4. Anchors teaching in the diverse life context of students
5. Encourages students to learn from each other
6. Employs authentic assessment.

The SSE Instructional Design Series (2007) also articulates several characteristics of contextualized teaching frameworks including:

1. Problem-solving within realistic situations
2. Learning in multiple contexts,
3. Content derived from diverse work and life situations
4. Authentic assessment.

According to Berns and Erickson (2001), contextual teaching strategy can be more fully described by identifying its characteristics of individual needs of students, and the teacher’s role. There are several explanations for the result of both characteristics, namely:

First, individual needs of students, where teachers are expected to do these tasks:

1. Plan lessons that are developmentally appropriate for the students.
2. Include interdependent learning groups.
3. Provide for an environment that supports self-regulated learning.
4. Include consideration of the diversity of students.
5. Address the multiple intelligences of students.
6. Include questioning techniques that enhance student learning and the development of problem-solving and other higher-order thinking skills.
7. Include authentic assessment.

Second, the teacher’s role in implementing contextual teaching strategywhich includes the following:

1. Preparing students with the education and technical skills they will need for successful employment in various careers or professions
2. Teaching students about all aspects of an industry
3. Enhancing academics by bringing real-world context and application, especially targeted to workplaces to education
4. Teaching students how to apply high-level math, science, technology, and language in workplaces and communities
5. Preparing high school students for college, should they and their families choose for them to attend
6. Preparing students with the academic foundation to be lifelong learners

Taken together, these characteristics suggest that contextual teaching strategy has several components that relate to the instructional activities, in which teachers’ concerns are taken into major account before accomplishing an educational objective.

To implement the contextual teaching strategy to the teaching-learning process, educators have outlined a variety of teachingapproaches that may be used. According to Johnson(2002), contextual teaching strategy is a holistic system with several components working together to create a systemic learning approach—suggesting that instruction and learning are derived from the whole and not from a discreet part.To her, contextual teaching strategy uses the components (eight teaching strategies) to connect academic lessons with real-world experiences so that meaning emerges. These components include:

1. Making meaningful connections: This strategy involvesconnecting the contents of a subject to the student'sexistingknowledge, past experiences, and othercurrent classes or situations.
2. Doing significant work:This involves doing things that seem important, practical, or usefulbecause when students view work as significant, they find it more meaningful and are more invested in it
3. Self-regulated learning:Self-regulated learning involves empowering students to make their own decisions and accept responsibility for them.
4. Collaborating: This involves exposure to social interaction. Research shows conceptual understanding improves significantly when students have the opportunity to discuss academic content with others, compare notes, and build on each other’s ideas.
5. Critical and creative thinking.This strategy involves helping students develop criticaland creative minds. According to Johnson (2002), “critical thinking is a systematic process that enables students to formulate and evaluate their own beliefs and claims” (p. 101). It allows students to say “This idea is a good one because it is supported by sound reasoning.” While creative thinking is a characteristic of people who have “the power to imagine possibilities…and to see things that the rest of us overlook” (p. 116). Consequently, critical and creative thinking complement each other, and both can play an important role incontextual teaching strategy. For instance, the creative mind discovers a new way to feed the homeless, while the critical mind studies the idea’s feasibility (ibid)
6. Nurturing the individual: This strategy involves the need forteachers to take the time to get to know and provide a nurturing environment for every student. This implies that this step requires teachers to studystudents’ different backgrounds, knowledge levels, interests, and learning styles to give them the necessary bits of help and chances that will enable them to achieve their potential.
7. Reaching high standards:This involvesraising the bar of our expectations for students through motivation.
8. Using authentic assessment: This strategy involvesevaluating students by assessing their ability to apply knowledge and skills to the types of situations that they are likely to encounter in the “realworld” (i.e., outside of the school environment).

Johnson argues that the components are enacted through the three guiding scientific principles of interdependence, differentiation, and self-organization. According to her, the principle of interdependence helps students establish connections that reveal meaning. It also promotes critical and creative thought, and encourages collaboration and working with others. The principle of differentiation supports the concept of diversity and the discovery of individual talents, styles, and skills. The principle of self-organization encourages students to evaluate evidence, examine alternatives, analyze information, make decisions, and create solutions. Consequently, all the activities support nurturing the individual, authentic assessment, clear objectives, and high standards.

In another development,Crawford (2001) developed five teaching approaches that include context as a critical component. The approach uses five essential forms of teaching which form the acronym REACT. The elements are: Relating, Experiencing, Applying, Cooperating, and Transferring. At the ‘‘Relating’’ stage new information is related to everyday situations. The ‘Experiencing’ stage points out learning in the context of exploration, discovery, and invention. The aim is to allow students to experience activities that are directly related to real-life work. At the ‘Applying’ stage, students apply concepts and information in a useful context through projects, activities, labs, text, and video. The ‘Cooperating’ stage points out learning in the context of sharing, responding, and communicating with other learners. This can be actualized via group activities such as projects, labs, problem-solving, realistic scenarios. At the ‘Transferring’ stage, students transfer skills and knowledge from one setting to another (CORD, 2000).Ingram (2003) described the REACT strategy as being grounded based on constructivism, in which students apply critical thinking and problem-solving activities to improve their understanding of concepts. The REACT strategy has been used mainly in science education literature to understand the concepts of impulse and momentum (U¨ltay, 2012a), acids and bases (Demirciog˘lu, Vural&Demirciog˘lu, 2012; U¨ ltay, 2012b), and the particulate nature of matter and heat (Aktas-, 2013). The common finding of these studies was that the REACT strategy was shown to be successful at remedying the misunderstanding of scientific concepts by using materials from daily life and the relevant context to attract students’ interest in a topic.

Suryawati, Osman,and Meerah(2010) outlined six contextual teaching techniques whichtheyadopted from REACT strategy and referred to as RANGKAcontextual teaching strategy.The strategy, RANGKA, is the acronym for *Rumuskan*(Conclude), *Amati* (Observe), *Nyatakan*(state), *Gabungkan*(Combine), *Komunikasi*(Communicate) and *Amalkan*(Implement). According to them the six components of RANGKA are some of the themes associated with REACT contextual teaching strategy that could help andcontribute to the learning of science, mainly Biology to get maximum results.The strategies of REACT approach which can be applied through the RANGKA strategy are problem-solving, learning from the environment, working in groups, making cooperation with society, and applying the learningmaterial through real experience (ibid).The stages involved in the implementation of the RANGKA strategy according to Suryawati (2010) are:

1. The planning, forming, and developing of contextual learning materials. At this stage, contextual learning materials are provided based on the student’s cultural surroundings to get them interested. They maintained that interesting material will provide students information, exposition; motivation toenrich their own experience, improve their self-confidence, and develops their ability and courage to make up their mind in the future.
2. The second stage involvesimplementation and the contextual learning activity. At this stage,lessons activities will be presentedusing hands-on material providedto connectconceptsto real-life to stimulate their motivation to learn more effectively.

These two stages are subdivided into six steps as follows: The first step is to analyze the problem (Conclude). Second, observe the object and beginlearning activity (Observe and Act) with the teacher being a facilitator. Next, state the result of observation and activity on paper (State). The fourthstep is to share the information in a group or seminar (Combine). Then one of the group members reports on theproblem-solving stage (Communicate). This means that the step involves working in a group where students solve problems throughquestioning and communicating with one another. The last step is application/implementation which is similar to the last approach of REACT strategy that is transferring of knowledge by applying what they have learned into a new experience. Rooted in the themes of REACT contextual teaching strategy, RANGKA strategy is describedas a teaching strategythat focuses not only on students’intellectual achievement but also on improving their scientific attitude towards learning(Suryawati, Osman &Meerah,2010). Their findings revealed that RANGKA'scontextual teaching strategy improves students’problem-solving skills in biology.

Other approaches for implementing contextual teaching strategy in works of literature are those summarized by Bernsand Erickson (2001). These include:

1. Problem-based learning is an approach that engages learners in problem-solving investigations that integrate skills and concepts from many content areas. This approach includes gathering information around a question, synthesizing it, and presenting findings to others (Moffitt 2001).
2. Cooperative learning is an approach that organizes instruction using small learning groups in which students work together to achieve learning goals (Holubec 2001).
3. Project-based learning, an approach that focuses on the central concepts and principles of a discipline, involves students in problem-solving investigations and other meaningful tasks, allows students to work autonomously to construct their learning, and culminates in realistic products (Buck Institute for Education 2001).
4. Service-learning is an approach that provides a practical application of newly acquired (or developing) knowledge and skills to needs in the community through projects and activities (McPherson 2001).
5. Work-based learning is an approach in which workplace, or workplace-like, activities are integrated with classroom content for the benefit of students and often businesses (Smith 2001).

The five teaching approaches according to Bernsand Erickson(2001) include context as a critical component; engaging students in an active learning process andabove all, they are not discrete meaning they can be used individually or in conjunction with one or more of the others. In this study, the REACT strategy developed by Crawford (2001) will be used as a teaching strategy in the experimental groups while the control groups will be taught utilizingthe lecture method.

**2.3.2 The REACT strategy**

REACT strategy is aContextual Teaching Strategy promoted by the Center for Occupational Research and Development (CORD)which was developed by Crawford (2001) to improve the learning of mathematics and science. The acronym (REACT) stands for what is referred to as five essential forms of learning: Relating, Experiencing, Applying, Cooperating, and Transferring. These five essential forms of learning that form the acronym, REACT, are encapsulated below to give a profound understanding of the relevance they bring to bear on the study.

**Relating:**

This is learning in the context of one’s life experiences or pre-existingknowledge (Crawford, 2001). Itis the most powerful contextual teaching strategy. Relating is often called the heart of constructivism. Relating is used to link a new concept to something completely familiar to students, thus this strategy will help them to link what they already know to the new information. When the link is fruitful, students gain almost direct comprehension. Caine and Caine (2000) call this reaction ‘felt meaning’ because of the ‘aha!’ sensation that often accompanies the insight. Crawford (2001) stated that felt meaning can be momentous, as when a student first sees the solution to a problem that he or she has spent significant time and effort in solving. Moreover, it can be subtle, as when insight leads to a milder reaction, such as, ‘Oh, that makes sense.’According to Crawford (2002), excellent teachers plan carefully for learning situations in which students can experience felt meaning. He added that careful planning is needed because often students do not automatically connect new information to the familiar. Research shows that, although students may bring memories or prior knowledge that is relevant to a new learning situation, they can fail to recognize its relevance (Bransford, Brown & Cocking, 2000). When teachers both provide students with opportunities to activate their memories or prior knowledge andrecognize the values of the pre-existing knowledge, they are using relating. Research also shows that learning is enhanced when teachers use relating, especially at the beginning of instruction with students’ prior knowledge and beliefs as a starting point, and then adjust teaching in response to students’ changing conceptions during instruction (American Association for the Advancement of Science, Project 2061, 1990). However, how do teachers know, or discover, their students’ prior knowledge and beliefs? There are three primary sources of this information. These according to (NCTM, 2006) are:

1. Experience – this could be from the teacher’s own experience with students of similar backgrounds or the collective experience of the teacher and his or her colleagues.
2. Research – from documented evidence of students’ commonly held ideas.
3. Probes – from carefully designed questions or tasks that reveal students’ prior knowledge and beliefs.

**Experiencing:**

Relating connects new information to life experiences or prior knowledge that students bring with them to the classroom (Crawford, 2001). However, this strategy is not possible if students do not have relevant experience or prior knowledge. This is why Crawford (2001), asserted that teachers could overcome this obstacle by helping them construct new knowledge with orchestrated, hands-on experiences that take place inside the classroom. This strategy according to Crawford (2001) is called experience. It is learning by doing—through exploration*,* discovery, and invention. He added that in-class hands-on experiences could include the use of manipulative, problem-solving activities, and laboratories.

1. Manipulative: Theseare defined as concrete objects used to help students understandabstract concepts in the domain of mathematics (McNeil &Jarvin, 2007).For example, in mathematics, base-ten blocks model numeric representation in the decimal system. Fraction bars demonstrate the meaning of simple fractions and the addition and multiplication of fractions. Area tiles model multiplication of polynomials. Some computer programs, such as Geometer’s Sketchpadand Cabri, can be considered manipulative since they enable students to visualize and explore concepts and to quickly see answers to “what if?” questions. Researches studies show that manipulative enhance student performance when they are coherently integrated into the curriculum (White &Frederiksen, 2000).
2. Problem-solving activities: These learning experiences engage students’ creativity while they are learning key concepts. These activities also teach problem-solving skills, analytical thinking, communication, and group interaction (Crawford, 2001). According to him, the best problem-solving activities introduce key concepts—usually curriculum objectives or standards—as they arise naturally in problem situations. He added that thisallows students to see a need or a reason for using the new concepts;and when they see relevant uses of knowledge in solving interesting problems, students can make sense of what they are learning (Bransford, Brown, & Cocking, 2000).
3. Laboratory activities and projects: These are usually longer and require more planning than problem-solving activities. In a laboratory, students work in small groups to collect data by making measurements, analyzing the data, making conclusions and predictions, and reflecting on the fundamental concepts involved in the activity (Crawford, 2001).

**Applying:**

Applying strategyasdefined by Crawford (2001) is learning byputting theconcepts touse. According to him, learning is enhanced when concepts are presented in the context of their use. Students apply concepts when they are engaged in hands-on problem-solving activities and projects. Students are motivated to learn mathematics when examples and student tasks include real-life problems that students can recognize from their current or possible future lives. He also added that applying is a contextual teaching strategy that develops a deeper sense of meaning⎯ a reason for learning. Moreover, the strategy fosters a second attitude that ‘I need or want to learn this.’

**Cooperating:**

According to Crawford (2001), cooperating is learning in the context of sharing, responding, and communicating with other learners. It has a positive effect on students’ achievement, interpersonal relationships, and communication skills. In addition, it improves students’ attitudes toward the opposite gender and other racial and ethnic groups (Hull, 2000). According to Crawford (2001)many problem-solving exercises, especially when they involve realistic situations, are complex. Therefore, students working individually sometimes cannot make significant progress in a class period and become frustrated unless the teacher provides systematic guidance. On the other hand, students working in small groups can often handle these complex problems with little outside help. Crawford (2001) asserted that teachers using student-led groups to complete exercises or hands-on activities are using the strategy of cooperating.Crawford (2001) also claims that working with their peers in small groups, most students feel less self-conscious and can ask questions without feeling embarrassed. In addition, they also will more readily explain their understanding of concepts to others or recommend problem-solving approaches for the group.

Another thing is that by listening to others in the group, students reevaluate and reformulate their sense of understanding. Moreover, many research studies show that cooperative or collaborative learning promotes higher student achievement than traditional individualistic and competitive methods (Davidson, 2000). Nevertheless, according to Crawford (2001), a greater understanding of academic concepts is not the result of simply placing students in groups and telling them to work together. Experience shows that some efforts at using cooperative learning can be counterproductive. For example, some students may not participate in the group processes at all, while others may dominate; group members may refuse to accept or share responsibility for the group’s work; the group may be too dependent on the teacher for guidance, and so on. Two of the leading researchers in cooperative learning, Johnson and Johnson (2000), have established guidelines to help teachers avoid these negative conditions and create environments in which students may be expected to learn concepts at a deeper level of understanding.

These guidelines include:

1. Structuring positive interdependence within student learning groups: Positive interdependence means that each student feels that he or she cannot succeed unless all the members of the group succeed.
2. Having students interact while completing assignments and ensuring that the interactions are on-task. Interactions include student-to-student help andencouragement, explanations of ideas and problem-solving strategies, and discussions of other ideas related to the assignment.
3. Holding all students individually accountable for completing assignments and not letting them rely overly on the work of others.
4. Having students learn to use interpersonal and small group skills: These skills include leadership, decision-making, trust-building, communication, and conflict management.
5. Ensuring that learning groups discuss how well the group functions. When students receive feedback on their participation in the group, they can reflect on their roles, if needed, adjust, and adapt their social skills to help the group meet its objectives.

Cooperative learning places new demands on the teacher. This is because the teacher must form effective groups, assign appropriate tasks, be keenly observant during group activities, diagnose problems quickly, and supply information or direction necessary to keep all groups moving forward (Crawford, 2001). As with the other contextual teaching strategies, the teacher’s role changes when he or she uses cooperative learning as in, he or she is sometimes a lecturer, sometimes an observer, and sometimes a facilitator (ibid).

**Transferring:**

Transferring asks students to use their new knowledge in a new context or a novel situation. This feature of the contextualized teaching classroom tests the actual understanding gained by the students. Instructors present new problems for students to solve or find an answer to. The problem-solving work requires students to draw on the newly acquired knowledge, demonstrate the depth of information integration, use requisite strategies, and exhibit ownership of the new knowledge.

**2.4 Concept of Algebra**

In contemporary educational settings, algebra is considered to be of vital importance for students’ continuation to more advanced studies in mathematics, thereby affecting their chances for future educationand employment (Kenneman, 2014). It also has high relevance and practical applications to many disciplines. For example, Consumer Advocates write and solve linear equations to determine which products and services will help consumers get the most for their money. That is why Davis (1995) claims that algebra can separate people from further progress in mathematics-related fields of study. In fact, in some developed countries, algebra is taken to be an integral part of early mathematics. For instance, in the United State of America, the National Council of Teachers of Mathematics through The Algebra Working Group (NCTM, 1997) and the National Council of Teachers of Mathematics [NCTM] standards (2000), proposed that activities that will potentially nurture children’s algebraic reasoning should start in the very first years of schooling. Accordingly, various documents of the U.S.NCTM Standards specify that all students in Grades 9-12 should learn to represent situations that involve equations and inequalities and that they should understand the meaning of equivalent forms of expressions, equations, and inequalities and solve them fluently (NCTM, 2000).

In another development, many educators have argued in recent decades that algebraic concepts should be taught at all levels of education (NCTM, 2000;Ferrini-Munday, Floden, McGrory, Burrill&Sandon, 2004;Moses, 2005). The reason for this as reported by NCTM, (2012) is that many researchers have described algebra as a set of skills that should be utilized across all mathematical topics, across all grades kindergarten through twelfth grade, and not as a stand-alone topic strand. Kaput, Carraher,and Blanton(2008), for example, clarified this: ‘Algebraic reasoning needs to develop over a long period in students’ mathematical experience, beginning in the early grades and engaging most mathematical topics’ (p. 100). Similarly, a report from the RAND mathematics study panel (2003) identified the teaching and the learning of algebra in kindergarten through 12th grades as one of the three focal areas in its proposed research agenda. Therefore, one may infer from the above demand that one of the main objectives of the teaching and learning of algebra is to give the students opportunities to develop their problem-solving skills, logical and analytical thinking to prepare them for practical life and to acquire the ability needed to solve problems in almost all fields of life.

Consequently, understanding algebraic concepts is a key to success at both junior and senior secondary school mathematics education because its skills will allow the students to explore other areas of mathematics as well as other mathematics-related subjects. In other words, if students are inept to handle questions from algebraic topics, then it may be more difficult for them to grasp and deal with questions successfully in other mathematical areas. For example, solutions to questions in a plane and solid shapes (mensuration) need students’ knowledge of algebra. Accordingly, it is suggested that students need more algebraic frameworks to develop their mathematical problem-solving skills and as well to enable them to perform better in mathematics and other mathematics-related subjects.

Going by the history of mathematics, algebra is one of the oldest branches of mathematics (Osei, 2005). The first examples of algebraic calculations were derived from Egypt andBabylon in about 1750 BC (Kiselman&Mouwitz, 2008). Of the two Babylonian algebraic calculations are far more advanced (Allen, 2002). The Babylonian ‘texts’ came in the form of clay tablets, usually about the size of a hand (Zara, 2008). They were inscribed in cuneiform, wedge-shaped writing owing totheir appearance to the stylus that was used to make it (Allen, 2002).Since the beginning of the 1800s, about half-million Babylonian clay tablets have been found, translated by the end of the 19th century (Teresi, 2002) and according to Johnson (2014) more than a thousand involve mathematics such as fractions, algebra, geometry, and Pythagorean triples. By the late 1920s, the study of Babylonian mathematics was well established and scholars attained a thorough understanding of the methods Babylonian mathematicians implemented for solving problems (Hoyrup, 2002). In 2000 BC, the Babylonians used algebraic methods in solving problems (Osei, 2005).They were familiar with many simple forms of factoring, three-term quadratic equations with positive roots, and many cubic equations although it is not known if they were able to reduce the general cubic equation (Boyer, 2001).An example of Babylonians algebraic work is a linear equation, which is, contains in the tablet YBC 4652: “I found a stone, but did not weight it; after I added one-seventh and then one-eleventh [of the total], it weighed 1 mina [= 60 gin]. What was the original weight of the stone?” and the correct was given (Katz, 2007, p. 21). This particular problem can be translated into the modern equation

(x + x/7) + (1/11) (x + x/7) = 60.

Another practical example of the Babylonians’ use of algebraic-type problems is the following: “I have added up seven times the side of my square and eleven times the area: 6; 15” (Hodgkin, 2005, p. 25). What this translates to is a square in which seven times the unknown side x (which is 7x) is added to eleven times the area (which is 11x2), which yields a result of 6; 15. This is equivalent to 6 + , which is equal to 6. Such a problem can be written as the basic quadratic equation 7x + 11x2 = 6. The Babylonians solved an equation like this about 3500 years ago by the methodical process even with their limitations in the different methods of solving quadratic equations as we have today; use of algebraic notations; scientific calculators and so on. However, the Babylonians used no mathematical symbols other than primitive numerals, and this lack of symbolism in algebra continued for many centuries (Osei, 2005). Gradually, some of the more common words used in mathematics were abbreviated, which led to a syncopated algebra. It has been said that in the historical development of algebra three stages can be recognized: (1) the rhetorical (prose) or early stage, in which everything is written out fully in words; (2) a syncopated or intermediate state, in which some abbreviations are adopted; and (3) a symbolic or final stage (Radford, 2007).

The ancient Babylonians were known to be the first to develop rhetorical algebra (the types of algebra in which problems are written in words) and this remained dominant up to the 16th century (Katz, 2007). The phase of syncopated algebra according to Fauveland Van Maanen, (2000) began around 250 AD when Diophantus introduced shortened notations which enabled him to rewrite a mathematical problem into an ‘equation’ (in curtailed form). Diophantus, as indicated by FauvelandVan Maanen, (2002), used the symbol ς to denote the unknown, additional unknowns were derived from this symbol (although they were not used in the calculations), and he systematically used abbreviations for powers of numbers and relations and operations.

The symbolic algebra (algebra using a symbolic model, which allows for manipulations on the level of symbols only) was established around 1560 and prepared by later abacus and classic algebra, Michael Stifel, GirolamoCardano, and the French algebraic tradition (Heeffer, 2007). FollowingStenlund (2014), the Greek mathematician who seems to have come closest to the conceptual transformation, in which the algebraic symbolism originated, was Diophantus of Alexandria (who lived in the third century AD, and who sometimes is called "the father of algebra"). Stenlund added that Diophantus of Alexandria was the author of a series of books called Arithmetica that deal with solving (what we call) algebraic equations. However, according to Klein (2004), it is François Viète (FranciscusVieta; 1540 –1603) who developed the logical and mathematical consequences of Diophantus’ work, and that deserves to be called the ‘inventor’ of modern mathematics.Klein says, “The term ‘symbol,’ used for letter signs as well as for connective signs, originated with Vieta himself” (Klein 1968)

Egyptian mathematics is less sophisticated than that of Babylon; but an entire papyrus on the subject survives and this is known as the Rhind Papyrus (Miatello, 2008). The Rhind mathematical papyrus, an over 5 meters long papyrus roll written on both surfaces, was found in the middle of the nineteenth century at Thebes in Upper Egypt and has been in the British Museum (BM 10057-8) since 1865, apart from small fragments separately traded, which are now owned by the Brooklyn Museum (37.1784E) (ibid). The Papyrus has a series of problems showing how to solve what we could call 'linear equations' by a method that became commonly used by merchants throughout the Mediterranean countries for some three thousand years, called the 'Method of False Position' (Rogers, 2009). It is used for all kinds of calculations involving the comparison of values and quantities. Most problems of the Rhind papyrus are concerned with daily matters of economic activities, such as farming, baking, brewing, and the distribution of goods (Miatello, 2008).Below is a portion from groups of problems classified by subject in the structure of the papyrus:Problems numbers 1–6: rations of bread; Problems numbers7–20: fractions multiplied by a factor; Problems numbers21–23: sekem “completion”; Problems numbers24–34: aha “quantity”; Problems numbers35–38: Metrologic aha “quantity”; Problems numbers41–46: granary capacity; Problem number 47: Metrologic conversion table (Imhausen, 2003).

Classical algebra was introduced in the Middle East (Osei, 2005). According to Calvin (2013), Muhammad Bin MusaAl-Khwarizmi was considered the founder of classical algebra. Classical algebra is learned today in middle and high school, and it developed irregularly over thousands of years by 1600 AD, most of the tools currently taught in middle and high school were in place (Brin, 2011). Standard topics of classical algebra include solutions to polynomial equations such as the quadratic equation: ax2 + bx + c = 0, the cubic equation: ax3 + bx2 + cx + d = 0, the quartic (also called the biquadratic) equation: ax4 + bx3 + cx2 + dx + e quintic equation:ax5 + bx4 + cx3 + dx2 + ex + f = 0.Solutions to the quadratic equation were known before 1000 BC, and solutions to the cubic and quartic equation were first published by Cardano in 1545 AD (Herbison-Evans, 2006). The quintic equation resisted all attacks until the early 1800s when it was finally understood that there was no formula of the expected type that gave the solutions (Brin, 2011).

Muhammad ibn Musa al-Khwarizmi was a mathematician and astronomer who lived in Baghdad around 800 A.D (Schipper&Spoelstra, 2010) and he was one of the people who came to study at this House (Meri& Bacharach, 2006). He was likely born in the region of Khwarezm, roughly where Uzbekistan is today (Berlinghoff&Gouvea, 2004). Al-Khwarizmi did a lot of work in astronomy and algebra. The word ‘algebra’ is derived from Latinization of ‘al-jabr’ (by Robert of Chester in the year 1145), part of the title of his book published in about 830 called Al-Kitab al-mukhtasar fi hisab al-jabrwa’l-muqabala translated to “The Compendious Book on Calculation by Completion and Balancing” (Boyer, 2001). The original Arabic print manuscript written by Al-Khwarizmi is kept at Oxford and was translated into English in 1831 by Fredrick Rosen (Heeffer, 2008).

It has been reported that the book,Al-Kitab al-mukhtasar fi hisab al-jabrwa’l-muqabala, is written with the encouragement of Caliph Al-Maamoun, the reigning Abbasid caliph of Baghdad in 813–33 AD (Rosdi, 2009). And that the book contains the solutions of problems men constantly require in cases of inheritance,legacies, partition, law-suits,andtrade, and all their dealings with one another, or wherethe measuring of land, the digging of canals, geometrical computation, and other objects of various sorts and kinds are concerned (Stenlund, 2014). Muhammad Bin Musa Al-Khwarizmi was the first Muslim man who had ever written on the solution of problems by the rules of completion and reduction (Katz, 2007). Two marginal notes in the Oxford manuscriptfrom which the text of the presentedition is taken and an anonymous Arabic writer, whose Bibliotheca Philosophorum is frequentlyquoted by CASIRI تاريخ الحكماء, written in the twelfth century (CASIRI Bibliotheca Arabica Escurialensis, T. i. 426. 428.) likewise maintain that this production of Muhammad Bin Musa Al-Khwarizmi was the first work written on the subject by Muhammad (ibid.).

The treatise provided an exhaustive account of solving polynomial equations up to the second degree, (Boyer, 2001, p. 228) and discussed the fundamental methods of "reduction" and "balancing", referring to the transposition of terms to the other side of an equation, that is, the cancellation of like terms on opposite sides of the equation (Boyer, 2001, p. 229). Roshdi(2009) writes:‘Al-Khwarizmi's text can be seen to be distinct not only from the [Babylonian tablets](https://en.wikipedia.org/wiki/Babylonian_mathematics) but also from the [Diophantus](https://en.wikipedia.org/wiki/Diophantus)' [Arithmetica](https://en.wikipedia.org/wiki/Arithmetica). It no longer concerns a series of [problems](https://en.wikipedia.org/wiki/Problem) to be resolved, but an [exposition](https://en.wikipedia.org/wiki/Expository_writing), which starts with primitive terms in which the combinations must give all possible prototypes for equations, which henceforward explicitly constitute the true object of study. On the other hand, the idea of an equation for its own sake appears from the beginning and, one could say, in a generic manner, insofar as it does not simply emerge in the course of solving a problem, but is specifically called on to define an infinite class of problems.’

Historically, classical algebra grew out of the arithmetic field of knowledge and is therefore often perceived as a generalization of arithmeticor as arithmetic with letters, that is, as operations on generalized numbers symbolized by letters instead of operations on numbers (Carraher et al., 2006; Mason, 2008). Moreover, modern (abstract) algebra (whose development started around 1800) grew from classical algebra (Brin, 2011). By the beginning of the 19th century, algebra had entered its modern phase and attention shifted from numbers and solving polynomial equations to studying the structure of abstract mathematical systems whose laws are based on the behavior of mathematical objects. According to Goddign (2011), during the 1920s and 1930s, Emmy Noether and Bartel van der Waerden brought19th-century algebra to a higher level of abstraction where the structures such as groups, rings, modules, fields, and vector spaces now define the image of algebra; equations and their solutions became an illustration in the margin of a theory that they originated initially. He added that, following this step to higher levels of abstraction, progress continued with transcendental extensions, an ‘algebraization’ of what a derivative of a function is, ideal theory, curves, and manifolds, which on the one hand appear to be special ideals in a polynomial domain, and on the other hand solution sets of a set of equations. Today, different areas of algebra have found applications in all mathematics-related courses as well as in many of the physical sciences.For example, linear systems (algebra) arise in applications to areas like business, economics, sociology, ecology, genetics, electronics, engineering, and physics.

Studies by experts have defined algebra in various ways. Piccitto (2002), defines algebra as a language through which most of the mathematics is communicated and it provides a means of operating with concepts at an abstract level and then applying them, a process that often fosters generalizations and insights beyond the original context. Redden (2011), sees it as a division of mathematics designed to help solve certain types of problems quicker and easier based on the concepts of unknown values called variables, unlike arithmetic, which is based on known number values. Booth (as cited in Welder, 2006, p. 3) stated that the main purpose of algebra is to learn how to represent general relationships and procedures; for through these representations, a wide range of problems can be solved and new relationships can be developed from those known. Zorn (2002), in addition, claimed that algebra involves much more than mastering basic skills; it also involves choosing a sensible strategy to tackle problems, maintaining an overview of the solution process, creating a model, taking a global view of expressions, wisely choosing subsequent steps, distinguishing between relevant and less relevant characteristics and interpreting results in a meaningful fashion.

Algebrais classified into different branches, one of which is school/elementary algebra (Kieran, 2003). Elementary algebra predominates the curriculum in secondary education and introduces the concept of variables representing numbers (Abonyi&Nweke, 2004). It is typically taught to secondary school students who are presumed to have little or no formal knowledge of mathematics beyond arithmetic as ‘algebra’ (Louis& Ralph, 2005). Kieran stated that: ‘elementary algebra is seen to focus on manipulative skills of simplifying, factoring, solving equations, functions and graphs, variables, word problems, and patterns’. Similarly, Linchevski(as cited in Welder, 2006) outlined high school algebra into five major themes: variables and simplification of algebraic expressions, generalization, structure, word problems, and equations. More broadly, Schmid and Wu (2008), claimed that elementary algebra incorporates the following concepts: symbols and expressions (polynomials expressions, rational expressions,etc), linear equations, linear inequalities, and their graphs, graphing and solving systems of simultaneous linear equations, quadratic equations (factors and factoring of quadratic polynomials with integer coefficients, completing the square in quadratic expressions, quadratic formula, and factoring of general quadratic polynomials and using the quadratic formula to solve equations), functions (linear functions, quadratic functions – word problems involving quadratic functions, graphs of quadratic functions, etc), algebra of polynomials (roots and factorization of polynomials), combinatory and finite probability.This study is limited to a quadratic polynomial (expression) and equations; hence the literature review will be based on those aspects.

Polynomial comes from two diverse roots: the Greek wordpoly, meaning "many," and the Latin nominal, or term (Peter &Seve, 2000).It is a special algebraic expression with terms that consist of real number coefficients and variable factors with whole-number exponents (Lipchitz & Lipson, 2007). It could be seen as any terms of the type anxn, where ‘a’ is a real constant and n is a non-negative integer (Matthew, 2013). Therefore, any expression could be considered as a polynomial if it is made up of number (constant), operations, one or more variables, and non-negative integral power.Polynomial in one variable (say x) according to Huggins, (2014) is an expression of the form:

anxn + an-1xn-1 + an-2xn-2 + ... + a 2x2 + a1x + a0,

where coefficients a0, a1, ..., an are constants, the leading coefficient an(a real number) is not equal to zero, the term anxnis called the leading term and *n*(the degree of the polynomial) is a positive integer.King (2009) revealed that the degree of the polynomial is the highest degree of a term with a non-zero coefficient. Thus the degree of 3x2+ 4x + 2 is 2 and the degree of 2x2− 4x4+ 1 is 4. The degree of a term in a polynomial is also defined as the exponent of the variable, or if there is more than one variable in the term, the degree is the sum of their exponents. A term with no variables is called a constant term or just a constant; the degree of a (nonzero) constant term is zero (Brin, 2011).In mathematics, a constant is a symbol, usually, a letter used to represent a number or some other object (ibid). Names are also assigned to polynomial according to their degree. Polynomials of degrees one, two, three up to eight are respectively called linear, quadratic, cubic, quartic, quintic, sextic, septic, and octic polynomials.Polynomial can also be classified according to its coefficient. Derek (2006) revealed that a real polynomial is a polynomial with real coefficients. Therefore, a real polynomial function is a function from the real to the reality that is defined by a real polynomial.

It was pointed out by Hall and Knight (2010) that polynomial expressions are either simple or compound. A simpleexpression consists of one term, as 3a2 or 3ax. A compound expression consists of two or more terms. Compound expressions may be further distinguished. Thus an expression of twoterms, as in 3a4+4a2, is often called a binomial, and one ofthree terms, as in a2 + 14ab−51b2, a trinomial. Simple expressions are frequently spoken of as monomials, and compoundexpressions as multinomial or polynomials. Therefore in this study, quadratic expression being a compound expression is regarded and classified as either binomial or trinomial.

Quadratic expression: According toHazewinkel (2001) the term quadratic comes from a Latin word quadratus meaning square and in mathematics, a quadratic expression is a polynomial expression of the second degree. Examples are x2+ 3x (a quadratic expression that has a common factor), x2− 9 (difference of two squares), x2+ 4x + 4 (a perfect square quadratic expression), and 2x2− 6x + 10 (a quadratic expression with two distinct factors). In these examples, the first two quadratic expressions are referred to as binomials (a polynomial expression of twoterms), while the last examples are trinomials (an expression of three terms). It follows from the definition of a polynomial that expression of degree 2 in the variable x called quadratic polynomial expression can be given by a2x2 + a1x + a0, where a0, a1 & a2 are constants and a2≠ 0. It can also be given as ax2 + bx + c, where a, b & c are real numbers and a ≠ 0 (MAN, 2007). Macrae et al. (2008) revealed that a quadratic expression is an expression in which the highest power of the variable (unknown) is two.

Quadratic expressions can be expressed (as a product of two linear- binomial- expressions) in factored form, depending on the type we are factorizing. Since the expansion of (x −4)(x − 6) = x2− 10x + 24, (x −4) and (x − 6) are the factors of x2− 10x + 24. Just as in arithmetic, 6 × 7 = 42 where 6 and 7 are the factors of 42. A quadratic expression may not have factors. In arithmetic, 17 is said to be prime since it has no factors other than itself and 1. Similarly, x2+ 2x − 6 has no factors (other than itself and 1). To factorize a quadratic expression is to express it as a product of its factors. Thus, x2− 10x + 24 factorises tobecome (x − 4)(x − 6). The following are steps, as posited by MAN (2007), that one should take while factorizing quadratic expressions (trinomials):

Step 1: Multiply the coefficient of the first term and the constant term and write down the pairs of factors of the product.

Step 2: Select the pair of factors whose sum is equal to the coefficient of the second/middle term and their product is equal to the result in step 1.

Step 3: Rewrite the expression by substitutingthe second term with the values in step 2.

Step 4: Group and factorize by isolating common factors in each group.

Quadratic equations:

Quadratic equations have been a fundamental topic, not only in secondary mathematics curricula around the world but also in the historical development of algebra (Schmid and Wu, 2008). It is an equality of the form (or can be brought to this form by the associative, commutative, and distributivelaws) ax2 +bx+c = 0 which asks for all the real numbers x that make this equality valid (a, b, c are constants and a ≠ 0) (Didis&Erbas, 2015). According to Parent (2015), a solution, or a root, of the equation is a real numberthat satisfies the equation, i.e., ax2+bx+c = 0. In other words, the “solutions” of the equation are when “x” is solved.Quadratic equations can have two real solutions, one real solution, or no real solution (Huggins, 2014). For instance, the quadratic equation x2+ x − 6 has two solutions, namely, x = −3 and x = 2. Quadratic equations can be solved by factoring, by completing the square, by using the quadratic formula, trigonometry solutions, Vieta's solutions, Bramagupta's methods, or by graphing (Williams, 2014). In this study, the literature reviewshall focus on the first three methods and the graphical method since they are the methods used in solving quadratic equations at the senior secondary school level.

Macrae et al.,(2014) posited that to solve quadratic equationby factoring i.e. to find its roots: (a) arrange the equation in the formax2 + bx + c = 0 (b) factorize the LHS if possible (c) apply the zero-product property which states that if the product of two real numbers is 0, then one of the numbers (or both of them) must be 0. That is,

if a × b = 0, either a = 0 or b = 0.

In a situation whereby a quadratic equation ax2 +bx+c = 0 does not factorize, he suggested that the equation should be solved either: (a) by completing the square, or (b) by applying the quadratic formula which is given as:

x =

The procedures of solving quadratic equation by completing the square as summarized by Okonet al.,(2008) are as follows:

(a) Bring all terms in the unknown variable, say, x, to one side, and all the terms without x to the other side.

(b) Divide through by the coefficient of x2.

(c) Take half the coefficient of x, square it and add it to both sides.

(d) Simplify the right-hand side of the equation (which does not involve x).

(e) Find the square root of both sides, remembering the positive and negative values.

(f) Hence, find the values of x.

The quadratic formula is derived through the method of completing the squares and it is the most general method of solving quadratic equations. Bunday& Mulholland (2004) stated that: For the general quadratic equation ax2+bx+ c = 0, where a, b, c are any real numbers with ‘a’ at least non-zero, we have after division by a and a slight rearrangement of terms

+x =

The addition of the quantity /4to both sides makes the left-hand side a perfect square, namely [ x +]2. Thus

(x+)2 = − =

Therefore

x + = ±√() =

x =

The expression, according to Bundayand Mulholland (2004), enables us not to solve quadratic equations but also to investigate the dependence of the roots on the relative values of a, b and c. In particular, the types of the root which arise depending on the quantity b2− 4ac, called the discriminant of the equation, whose square root occurs in the expression.

The quadratic equation ax2 +bx+c = 0 can be solved graphically, by drawing the graph of the function y = ax2 +bx+c which is obtained by plotting the function y = ax2 +bx+c against x (Wallace, 2010). The x-coordinate of the point where the graph meets the x-axis is the roots of the equation ax2 + bx + c = 0 (Otto, 2015). To draw the graph of y = ax2 +bx+ c easily and correctly, MAN (2007) proposed the following techniques:

(a) Make a table of values of y against x.

(b) Plot the graph of thequadratic equation by:

1. Choosing a scale such that our graph is as large as possible and also occupies the center of the graph sheet. This will enable us to obtain the points where the graph cuts the x-axis more easily.
2. Joining the points in our graph by a smooth curve (using freehand).

For this study, quadratic expressions and quadratic equations will be concretized using manipulative. The reason for this is that research findings show that the use of manipulative might ease or erase the students’ difficulties regarding quadratic factorization (Hoong&Fwe, 2010). It was also revealed that manipulative enhances students’ performance when they are coherently integrated into the curriculum (White &Frederiksen, 2012). These mathematical manipulative are defined as any materials or objects from the real world that children move around to show a mathematics concept (Schweyer, 2013). They are simple objects or hands-on learning activities that students can move around to model abstract concepts concretely (ibid). From an analysis of 1996 National Assessment of Educational Progress (NAEP) test data for two nationalsamples of approximately 15,000 8th grade students: ‘Students whose teachers conduct hands-on learning activities outperformed their peers by more than 70% of agrade level in mathematics and 40% of a grade level in science’ (Wenglinsky, 2014). It is in line with this that the study chooses to use manipulative as its experiencing strategy to help students understand the concepts of factorization and solutions to quadratic equations.

**2.5 Concept of Academic Performance in Algebra**

The definitions of academic performance based on the past literature are legion. Chen (2007) defined academic performance as a student’s academic performance in school. Adu, Ojelabi,andAdeyanju (2009) viewed it as an outcome of all academic tasks and rigors of a person, which could be poorly or successfully stated. Nneji (2013) considered academic performance as the gain in knowledge of students because of taking part in a learning activity or program. More broadly, Wikipedia (2015) defined academic performance as the outcome of education - the extent to which a student, teacher, or institution has achieved their educational goals. In this study, academic performance is conceived as the students’ performance in the Mathematics test in the area of Algebra after being exposed to a new teaching strategy.

Mathematics educators, researchers, as well as trainers have long been searching for variables that determine the quality of students’ mathematics academic performance. Past literature reviewed that several variables influence students’ academic performance in mathematics. These variables by the conceptions of Lamb and Fullarton (2000) can be classified into three factors namely: student, classroom, and school factors. Student factor includes sex, number of books in students’ home, socioeconomic status of parents, parents’ education, parental involvement in students’ activities, family size, level of skill in the language of test, and conscientiousness. Research findings of Lamb and Fullarton (2000) on the factors affecting mathematics achievement in primary and secondary school indicated that girls’ achievement levels were still not equal to that of boys at either primary or secondary level meaning gender has a significant negative effect on mathematics achievement. Nevertheless, study shows that students’ achievement generally, in mathematics can be influenced by home background variables such as parents’ level of education, number of books at home, and possessing of dictionaries, computers, and study desks (Easton-Brooks & Davis, 2007). It was also observed by Katherine (2009) that highly educated parents tend to have more stimulating environments, which in turn can influence students’ academic achievement. As for socioeconomic status, experts argue that low socioeconomic status harms the academic performance of students because the basic needs of students remain unfulfilled and hence they do not perform better academically (Adams, 2001). The academic performance of students also depends upon parental involvement in their academic activities to attain a higher level of quality in academic success (Shumox& Lomax, 2001;Henderson, 2003; Barnard, 2004). Students with higher mental ability as demonstrated by intelligence quotient (IQ) tests and those who are higher in conscientiousness tend to achieve highly in an academic setting (Wikipedia, 2015). Student mediating variables such as time spent on homework, attitudes towards mathematics, and perceived importance of mathematics are also influential predictors of mathematics achievement (Perth & Hay, 2016).

Research on the impact of school factors (i.e. school size, mean socioeconomic status,etc) on students’ academic achievement shows that none of the school factor variables was found to have any direct or indirect effect on the mathematics achievement of students (Lamb &Fullarton, 2000). However, Marzano (2003) pointed out that the school authorities can provide counseling and guidance to parents for creating a positive home environment for improvement in the students’ quality of work.Classroom factor includes teachers’ variables, classroom climate (pupil-teacher ratio), and gradelevel (Lamb, 2002). The classroom climate such as the number ofstudents in the classroom and the commitment of thestudents calms and quiet in the classroom were found to have influenced the students’ achievement (Mohammed et al., 2012). Similarly, research findings also indicated that there is a significant impact of pupil-teacher ratio diminution on test scores in some contexts (Krueger & Whitmore, 2002). In contrast, BanerjeeandSubramaniam (2004) explained that there is no effect of the reduction in pupil-teacher ratio achieved through the hiring of a remedial education teacher for students who remained with the regular teacher.

Teacher’s variables involve the sex of the teacher, qualifications, years of teaching experience, the amount of homework the teacher sets for the mathematics class, the amount of time they spend teaching mathematics, and the extent of the teacher’s reliance on mathematics textbooks and his/her teaching method/strategy (Larkin,2001 & Anderson, 2003). Concerningteacher’s variables, Silva et al., (2006), claims that students are bound to failmathematics if teachers’ academic preparedness (content knowledge), years of teaching experience, attitude, teaching styles, and beliefs are not adequate or positive. Corroborating this statement, Mohammed (2011), declared that teachers’ characteristics and their behaviors in the classroom have a significant influence on students’ achievement in mathematics. The finding of Hebert andGrouws (2007) on the effect of classroom mathematics teaching on students learning indicated that when teaching promotes constructive struggle with mathematics, students’ understanding increases. All these explain that teachers should carry the major part of the blame on the poor performance of students in mathematics. This is because when they employ an inapt teaching method/strategy that does not allow the restructuring of teaching and learning materials that match their learning styles, and if they are unapproachable, more authoritarian, and less humane in their teaching approaches students are bound to lack a proper understanding of mathematics.Giventhese reviews, this study looked at teaching strategy as a variable from classroom factor, to find out the influence it has on students’ performance in mathematics in the area of algebra.

**2.6 Concept of Students’ Attitude towards Algebra**

Attitude has always been a subject of interest to many educational researchers as it plays a vital role in determining an individual’s personality. Psychologists, as well as researchers, have given different but similar definitions of attitude. According to McGuire (2001), attitude is defined as the predisposition to clarify sets of objects or events or to react to them with some degree of evaluative consistency. Ani (2002) describes attitude as the way an individual feels and is predisposed to act towards some aspect of his/her environment. Attitude is regarded by Gagne (2006) as a state that influences or modifies the individual choices of personal action. Such choices of personal action can be easily noticed in a person’s response or reaction to any situation. To Lamon (2003), attitude is a system of positive or negative evaluations, emotional feelings, and pro or con action tendencies to social objects. Likewise, Obodo (2005) defined attitude as a favorable or an unfavorable reaction towards some experiences, situations, or activities as a result of the way such an individual perceives and conceptualizes them. Attitude was also seen as a means for meeting some needs of the individual because it is concerned with people’s opinions, actions, and behaviors. Harbor-Peter (2005) pointed out that opinions expressing people’s likes or dislikes are conveyors of, and hence, means of ascertaining one’s attitude towards an object or event.

According to the Multicomponent model of Attitude (Eagly&Chaiken, 2003), attitudes are influenced by three components. They are cognitive (beliefs, thoughts, attributes), affective (feelings, emotions) and behavioral information (past events, experiences) Schau, Stevens, Dauphinee, and Del Vecchio (2005).Maio, Maio, & Haddock, (2010). structured attitude into four components or dimensions: affective, related to positive feelings towards mathematics; cognitive, as the perception of one’s capacity for knowledge and thinking skills in mathematics; the value, as the usefulness, the relevance, and perceived value of mathematics in common life, personally and professionally, and finally, the component of difficulty, which focuses on the perception of mathematics as a subject, even if the student can recognize its usefulness (component value), and have interest towards it (affective component) and think that they have enough skill and knowledge (the cognitive component) and still consider the subject to be easy or difficult.

More broadly, works of literature reviews on students’ attitudes towards mathematics revealed that several factors play a vital role in influencing students’ attitudes. These factors according to Muhammad and Abdulwaheed (2011) can be categorized into three distinctive groups. Firstly, factors associated with the students themselves include students’ mathematical achievement score (Köğce et al., 2009), students’ anxiety towards mathematics, student’s self-efficacy and self-concept (Tahar et al., 2010), and students’ experiences at high school (Klein, 2004; Bobis&Cusworth, 2004). Secondly, the factors that are associated with the school, teacher, and teaching: teaching style and behavior(Papanastasiou, 2000), teaching techniques (Anderson, 2005), teaching methods(Beswick, 2006), private tuition(Harkness, D’ Ambrosio&Morrone, 2007), teachers’ attitudes(Köğce et al., 2009)and beliefs towards mathematics and teachers’ attitude toward mathematics (Karp, 2012). Thirdly, factors from the home environment: occupation and educational background of parents (Köğce et al., 2009) and parental attitude, beliefs and expectations ( Hannula, 2002; Tobias, 2003;Tapia & Marsh, 2004) which play a crucial role in influencing students’ attitude towards mathematics.

Inanother development, the qualitative research findings of Çigdem, Sadegül,andSinan (2009), aimed at determining the factors that affect 7th-grade students’ attitudes towards mathematics course indicates that (a) using different materials in teaching, (b) teachers’ classroom management skills, (c) teachers’ content knowledge and personality, (d) teaching topics with real-life enriched examples, and (e) students’ opinions about mathematics courses, were the factors that affect students’ attitude towards mathematics courses. Wilkins and Ma (2005) also pointed out that researchers identified six main factors that were found to affect or influence students’ attitudes towards mathematics and that those factors can be classified into five themes. Firstly, teacher characteristics such as qualified, unqualified, funny, nice, unapproachable, and devoted teacher will go a long way to determine the type of attitudes (positive or negative) students develop towards mathematics, in the area of algebra. Secondly, teaching characteristics in terms of clarity of teacher’s explanation using appropriate teaching strategy, instructional materials, and multiple representations, such as graphically and algebraically influenced students understanding of mathematics and, hence, their attitude toward mathematics. Thirdly, classroom characteristics such as size and the environment it creates affect students’ attitude towards mathematics; the smaller the classsize, the easier it for the teacher to manage to meet the mathematics need of all the students. Fourthly, assessments and achievement: students found that their attitudes improved as their achievement in mathematics improved. Fifthly, individual perceptions and characteristics such as early family experiences, individual perceptions on challenge and frustration levels, a sense of accomplishment, and a level of understanding were believed to impact students’ attitudes.

Due to the aforementioned factors, students have a different attitude towards mathematics.More often, the public image of mathematics is labeling it as a difficult, cold, abstract, theoretical, and ultra-rational subject (Ernest, 2004). However, some studies show that students have a relatively positive attitude towards mathematics (Fanet al., 2005; Tezer&Karasel, 2010; Yilmaz, Altun, &Ollkun, 2010). Sometimes, Mathematics is also considered a very important and largely masculine subject (Ernest, 2004). Several studies give evidence that compared to boys, girls lack confidence in doing mathematical sums and view mathematics as a male domain (Hydeet al., 2000; Meelissen&Luyten, 2008; Odell &Schumacher, 2009). However,many studies suggest that there is no significant difference between attitudes towards mathematics among male and female students (Nicolaidou&Philippou, 2003; Köğce et al., 2009;Muhammad &Abdulwaheed, 2011). Farooq and Shah (2008) in a study of secondary school students in Pakistan found that there was no significant difference inthe confidence of male and female students towards Mathematics at the secondary school level. They rather found thatstudents’ success in Mathematics depended on attitude towards the subject.

Research findings also indicated that learners draw from the teachers’ disposition to form their attitudes which may affect their learning outcomes(Yara,2009). According to Bolhuis&Voeten(2004), teachers with a positive attitude towards Mathematics were inclinedto stimulate favorable attitudes in their pupils.It was found that a teacher’s characteristics such as qualified, unqualified, funny, nice, unapproachable, and devoted teacher will go a long way to determine the type of attitudes (positive or negative) students develop towards mathematics (Popham, 2006). Also, teachers’ attitudes and beliefs play a verysignificant role in shaping classroom practices (Mensah, Okyere & kuranchie, 2013).

Research findings also indicated that effective teachers facilitate learning by truly caring about their students’ engagement and creating the right atmosphere that enhances student learning (Noddings, 2002). They have high yet realistic expectations about enhancing students’ capacity to think, reason, communicate, reflect upon and critique their practice, and they provide students with opportunities to ask why the class is doing certain things and with what effect (Watson, 2002). Thus the relationships that develop in the classroom become a resource for developing students’ attitudes and Mathematical competencies and identities. At this point, one could conclude that teachers maintained a potent force in the classroom. Corroborating this statement, the research findings of Alebiosu & Bamiro (2004) indicated that teachers are found to be very important determinants of attitude towards school subjects. Teachers according to the Ministry of Education, Ontario (2007) can foster in students the positive attitudes aboutMathematics that help to build confidence by encouraging the belief that everyone can ‘do’ Mathematics–emphasizing effort, not innate ability; modeling enthusiasm for teaching and learning Mathematics; addressingthe learning styles of students by providing a variety of ways for students to gain an understanding of difficult concepts; helping students to appreciate the value of Mathematics in their lives, and choosing activities carefully (not too easy, not too hard), so that students can be both challenged and successful.

Beyond any doubt, this review indicated that teachers who use an effective teaching strategy that articulates several components working together to help students find and create meaning through experience, drawing from prior knowledge to build upon existing knowledge, can nurture in students the positive attitudes towards Mathematics. Several studies have also pointed out that effective teaching strategies can influence students’ attitudes towards mathematics. A few among theminclude: teachers who use innovative instructional strategies stand a higher chance of positively influencing the attitudes of the learners to school subject (Guzel, 2008); students attain higher achievement and positive attitude in mathematics by using simulation-games strategy (Abiodun & Olutola, 2010); effective strategy promote the enjoyment of learning and positive attitude towards mathematics (Australian Association of Mathematics Teachers, 2002); attitude of students can be influenced by the attitude of the teacher and his method of teaching (Yara, 2009); the analysis and interpretation of data of the Attitude to Mathematics Inquiry and Enjoyment of Mathematics Lessonslead credibility to the idea of attitudinal change being engendered to the implementation of the instructional strategy (Tuck-Choy, 2011). Accordingly, the search into a viable instructional strategy that could facilitate the development of a more positive attitude towards the learning of mathematics should be of great concern to researchers. It is on this note that this research seeks to investigate the effect of contextual teaching strategy in remedying the students’ negative attitude towards mathematics particularly, algebra, to the slightest level.

**2.7 Students’ Attitude and Academic Performance in Algebra**

In both junior and senior secondary school mathematics contents, algebraic concepts areseen as the main/useful tools. It serves as a tool for solving equations, creating formulas for problem situations, working with functions in terms of formulas, finding derivatives and constructing tables, and drawing graphs among others, in virtually all the topics of mathematics at the senior secondary school level. For example in geometry, algebraic methodsare used when solving geometric problems, especially when synthetic techniquesbecome cumbersome, e.g., the synthetic proof of the Pythagoras Theorem which anaverage geometry student usually finds somewhat difficult to follow; the deductive reasoning’s of vertical, adjacent, complementary and supplementary angles in geometry also make use of algebra. Likewise in the derivation of a sum of angles, algebraic knowledge is needed. Therefore, it stems from the above that the teaching and learning of mathematics particularly, algebraic concepts, is core as it is the linchpin in the studying of other branches of secondary mathematics. However, despite the vast usage of mathematics particularly, algebra, and the effort made by the government, researchers and different educational bodies for quite some years back to promote effective mathematics teaching at all levels of education in Nigeria, students’ performance remain poor (Akanmu & Fajemidagba, 2013).

This persistent problem of poor academic performance in mathematics in Nigeria to a large may be attributed to students’ attitude towards mathematics because according to Schreiber (2000), positive attitudes are conducive to good performance. The findings of Alrwais (2000) about the relationship among the factors; students’ attitude toward learning mathematics, students’ mathematical creativity and students’ school grades, and their effect on achievement in mathematics indicated that the best predictor was the students’ attitude toward learning mathematics. The studies on the relationship between students’ attitude and the students’ academic performance also show a positive relationship (Papanastasiou, 2000; Nicolaidou & Philippou, 2003; Ma & Kishor, 2007; Bramlett & Herron, 2009; Muhammad & Abdulwaheed, 2011). A different study also suggested that extremely positive or negative attitudes tend to predict mathematics achievement better than mere neutral attitudes (Bergesonet al., 2012).

However, Scott (2001) has reported that although there is a relationship between attitude and achievement, this relation should not be considered definite. Hence, being merely aware of an individual’s attitude towards a subject is a weak predictor ofhis subsequent performance (Ghanbarzadeh, 2001). Accordingly, severalresearchers have identified some other reasons that account for the poor performance of senior secondary students in algebra. One of the reasons is that many students find it abstract and difficult to comprehend (Witzel, Mercer& Miller, 2003). In a clearer form, the reasons aredifficulties with the transition from arithmetic to Algebra (Cooper &William, 2001); lack of understanding of the precedence of operations with algebraicterms, unknowns, and letters as generalized numbers (Vlassis, 2002); translating word problems from natural language to algebraic language (Kieran, 2003); misunderstand the equal sign as an operator, that is, a signal for ‘doing something rather than a relational symbol of equivalence or quantity sameness (NCTM, 2000); lack of understanding of the basic concept of the variable in different contexts(Bush & Karp, 2013); misinterpretationof symbolic notations(Kilhamn, 2014)and so on.

All the aforementioned reasons/problems highlighted the importance for teachers to search for an effective teaching strategy that will create a deeper knowledge of the algebraic concepts in the minds of the students. Algebra deals with letters or symbols**.** Letters or symbols are abstract objects in thesense that they are de-contextualized (Lew, 2004).According to Kieran (2006), students’ learning difficulties are centered on the meaning of letters, the change from arithmetical to algebraic conventions, and the recognition and use of structure. Wagner and Parker (2013) agree with Kieran that most obstacles inherent to algebra stem from notational conventions or the complexity of concepts that arise with the use of letters as variables. In addition, some of these problems are amplified by teaching approaches.

The teaching methods used to convey the contents often exacerbate these algebra-learning barriers, possibly becoming a unique barrier themselves (Rakes et al., 2010). Teaching methods that focus on a skill orprocedural levels rather than the relational understanding of abstract mathematical ideas(often requires a lengthy, iterative process) are often insufficient for helping studentsunderstand the abstract, structural concepts necessary for supporting thedemonstrated procedural activities in algebra (Kieran, 2003; Rakes et al., 2010). Asa result, many students fail to construct meaning for the new symbolism and arereduced to performing meaningless operations on symbols they do not understand (Drijvers, 2011).

The contextual teaching strategy is a promising strategy because according to its theory, learning occursonly when students process new information or knowledge in such a way that it makes sense to them in their frames of reference (CORD, 2000). Contextual teaching theory focuses on the multiple aspects of any learningenvironment. It encourages educators to choose and/or design learning environments that incorporate as many different forms of experience in working toward the desired learning outcomes (ibid). It allows students to learn new concepts within a concrete and memorable context (Predmore, 2005). It has the potential to motivate and effectively engages students who view mathematics as a boring or difficult subject, or who have struggled to make the connections between the demands of the classroom and their personal goals and aspirations (ibid). Therefore, there is no doubt that this strategy will get rid of the students’algebra’s abstractness and difficulty and in turn, will stimulate the students to learn algebraic concepts, influence their academic performance, and enhance their attitudes towards it.

**2.8 Overview of Related Studies**

Wiseley (2009) investigated the effect of contextual teaching approaches to developmental mathematics in California Community Colleges (CCC). The purpose of this study was to examine the extent and effectiveness of using contextualized formats for delivering basic skills instruction in California Community Colleges and the ability to transfer those learning skills to another context or courses that would require not only further application but an adaptation of those learning skills. The study used a mixed-method - quantitative and qualitative techniques, design to identify colleges and courses using basic skills mathematics instruction in the context of an occupational program. Out of the total population of 110 California community colleges accredited as of fall 2007, 35 colleges were used as a sample with a total number of 17,152 students and grouped into three categories:

1. 'Standard 9' represents the group of students in the standard basic skills courses at the nine colleges exposed to a contextualized basic skills course
2. ‘Standard 25’ represents the group of students in standard basic skills courses at the 25 colleges that are not exposed to contextualized basic skills courses at their colleges.
3. ‘Vocational Status’ indicates that the student enrolled in a vocational course above the introductory level during the same term as the mathematics course.

Three hypotheses that guided the study were tested at 0.05 level of significance. Logistic regressions were used to analyze students' level data from the California community college system office database for contextual and non-contextual basic skills mathematics courses. Bivariate analysis using Chi-square tests independence for each of those outcomes for the three combinations of student groups (i.e., Standard 9 vs. Standard 25, Contextual vs. Standard 9, and Contextual vs. Standard 25) revealed that:

1. Students taught contextual basic skills mathematics courses had better performance than those exposed to standard mathematics basic skills courses at all the responding colleges.
2. In all of the comparisons mentioned above the is no significant difference between the performance of male and female students taught contextual basic skills mathematics courses as both genders achieved higher learning outcomes than those exposed to standard mathematics basic skills courses
3. Contextual basic skills mathematics courses were scarce at the responding colleges.

The previous study is related to the present study because it has three variables in common: academic performance, gender, and the teaching method. But the previous study differed from the current study as it left out some variables such as students' attitudes and algebraic concepts. Therefore, the previous study has notified the current study to fill some gaps that exist between them. Hence, the current study investigated the effect of contextual teaching strategy on attitude and performance in algebra among selected public senior secondary school students in Zaria Educational Zone of Kaduna State, Nigeria.

Sunday et al. (2021) investigated the effect of contextual teaching strategy on geometry achievement of students in junior secondary schools in Katsina metropolis of Katsina state. The study adopted a quasi-experimental pre-test post-test control group research design. A sample of 144 students comprising 78 boys and 66 girls from two randomly selected private schools in Katsina metropolis of Katsina state was used for the study. Two research questions and two null hypotheses were tested at 0.05 level of significance. The instrument used in the study was Geometry Achievement Test (GAT). Data obtained from this study were analyzed with descriptive analysis, followed by subsequent inferential analysis in the form of mean, standard deviation, and t-tests. The results of the findings revealed that students taught geometry concepts with contextual teaching strategies performed better than those taught with a conventional method. In addition, there was no significant difference between the average performance score of male and female students taught geometry with a contextual teaching strategy. The previous study has provided empirical evidence indicating the efficacy of contextual teaching strategy on the achievement of female and male junior secondary students in geometry. In particular, it indicated that contextual teaching strategy had a significant effect on students' achievement in geometry concepts over those taught using conventional approaches and it is gender-friendly.

Kamaruddin and Amin (2009) examined the effect of contextual laboratory activities in the learning of engineering statistics at the University of Tun Hussein Malaysia. A total of 155 participants were drawnfrom a population of 265 students who were taking BSM 2922 Engineering Statistics in their second semester, through a random sample technique from the faculty of civil, mechanical, and electrical engineering, UTHM, Malaysia. The study employed a quasi-experimental research design. The experimental group received contextual laboratory activities while the control group had non-contextual laboratory activities. Engineering Statistics Concepts Test (BSM 2922) and Attitude Scale toward Engineering Statistics were administered to the subjects as pre-test and post-test. Two hypotheses formulated to guide the study were tested at 0.05 level of significance. Data obtained were analyzed using descriptive and inferential statistics. Descriptive analysis revealed that the post-test mean score of the students in the experimental group was higher than the control group which indicated that contextual laboratory activities have positive effects on students' attitudes towards engineering statistical concepts. Inferential analysis of the t-test revealed that there was a statistically significant difference in performance in engineering statistical concepts in favor of the experimental group. It was concluded that the students who received contextual laboratory activities achieve high learning outcomes. Although the previous study focused on statistical concepts since it utilized contextual laboratory activities, one of the five elements of contextual teaching strategy – Experiencing, developed by Crawford (2001); the same variables – attitude and performance; and the same design, therefore the previous study is relevant to the current study. However, the former study did not investigate whether the strategy affects gender on attitudinal change and performance towards the concepts. Therefore this study filled the gap that exists while employing contextual teaching strategy and focusing on algebraic concepts.

A similar effort was made by Amin et al., (2014) in Malaysia, with 15 students each randomly sampled from two groups of engineering students: 62 mechanical and 68 electrical engineering students, at the department of engineering UTHM, Malaysia. The purpose of this study is to investigate the impact of contextual teaching strategy on academic performance in engineering statistical concepts among mechanical and electrical engineering students who have undergone statistics concepts in their second semester. Two hypotheses were also formulated and tested at 0.05 level of significance. The instruments used were questionnaires and statistics achievement tests (SAT). Data obtained were analyzed using inferential statistics. The findings indicated that the experimental group had better performance in statistical concepts than the control group. The study of Amin et al. is related to the present study in the use of teaching methodology and both studies have academic performance in common. However, the previous study has left some important variables such as students' attitudes and gender. While the previous study focused on statistics concepts at the tertiary institution, this study was targeted at algebraic concepts at the public senior secondary school level in Zaria Educational Zone of Kaduna State, Nigeria.

Suryawatiet al. (2010) investigated the effect of contextual teaching strategy on students' problem-solving skills and scientific attitudes in Pekanbaru, Indonesia. A sample of 215 form VII students from three government schools segregated based on their existing cognitive abilities; viz. high, moderate, and low, constituted the subjects of the study. The study adopted a pretest-posttest control group quasi-experimental design. Two instruments used in the study were: problem-solving skills ability scores (PSAT) and scientific aptitude test (SAT). Two hypotheses that guided the study were tested at 0.05 level of significance. A pre-test was administered before treatment to establish the equivalence of the experimental and control groups. In the study, the contextual learning module was developed by applying RANGA contextual teaching strategy which has been adopted from REACT strategy, covering the topic of organism diversity. The experimental group was taught using RANGA contextual teaching strategy while the control group was exposed to the lecture method. Data obtained from this study were analyzed with descriptive analysis, followed by subsequent inferential analysis involving a series of t-tests, ANOVA, and MANOVA analyses as the study involved two learning groups with different cognitive abilities. The results of the findings revealed that RANGA contextual teaching strategy had a significant effect on students' ability in terms of their problem-solving skills across the experimental group (High,Moderate, andLow ability learninggroup). However, there is no significant difference in terms of their scientific attitude in both learning groups. This might be because Biology is one of the subjects that have a direct relation with real-life experience, which implies that both groups benefitted equally from that opportunity. But above all, such a pattern of findings provides empirical evidence which signifies the use of contextual teaching strategy in enhancing problem-solving skill ability which in turn could improve performance, in the teaching and learning of Biology.

This work is related to the present work as it has some variables in common: contextual teaching strategy, lecture method, and attitude. However, they differ in several ways. Their study aimed at finding the effect of contextual teaching strategy on the problem -solving skills and scientific attitude among form VII students with different cognitive abilities in Biology while this present study focused on the effect of contextual teaching strategy on attitude and performance in algebraic concepts among senior secondary school II male and female students. Two (2) null hypotheses guided the former study while the present study was guided by four (4) null hypotheses. The former study utilized RANGA contextual teaching strategy which was adopted from REACT strategy while the present study will utilize the REACT strategy, one of the contextual teaching strategies developed by Crawford (2001). So in the former study, the effect of contextual teaching strategy on students' academic performance as well as their gender was not investigated. This aroused the researcher to conduct this research to see the efficacy of the strategy on these two important variables. Hence, this study investigated the effect of contextual teaching strategy on attitude and performance in algebra among selected public senior secondary school students in Zaria Educational Zone of Kaduna State, Nigeria.

Komalasari (2012) used a quantitative approach with a survey method to describe the effect of contextual teaching strategy in Civic Education on students' civic skills competencies. The population of the study was all the 93 grade nine state Junior High School students in West Java, Indonesia taught social competence and independence by teachers who had Competence-Based Integrated Training − contextualized training package. A sample size of 1,004 students was used. Two instruments namely: Survey of Study Habits and Attitudes scale questionnaire, developed and validated; and Civics Assessment Database was used to collect data. Their civic achievement scores before and after the treatments were used to determine their civic competencies. Data collected were analyzed using Analysis of Variance (ANOVA) at 0.05 level of significance. The result of findings showed that contextual teaching strategy had a significant effect on students' civic skills competencies and attitudes. Although the previous study focused on civic education it related to the present study in terms of teaching method and attitude.

Adamu (2020) investigated the effect of Contextual Teaching-Learning approach on the attitude of Senior Secondary School Students to plane geometry. in two Educational zones of Kaduna State. A sample comprised of 49 SSS 3 students was drawn from the population of 1,166 senior secondary schools three through simple random sampling technique from 19 public senior secondary schools in Zaria and Giwa educational zones. The study adopted the pretest and post-test, quasi-experimental design. One research question and one hypothesis were formulated to guide the study. The instrument used was a mathematics attitude questionnaire (MAQ) which was adopted from Schackow (2005). The data collected was analyzed at 0.05 level of significanceusing t-test statistics. The findings showed that the contextual teaching-learning approach had a significant positive effect on students' attitudes to plane geometry. While this study and the previous one implemented the same teaching strategy, the REACT strategy, there is a big difference between the two studies. The previous study focused on the effect of the contextual teaching-learning approach on a single variable, attitude, which implies that the study has left some important variables, such as performance and gender, that the current study aimed at considering in its findings. One (1) null hypothesis guided the former study while the present study was guided by four (4) null hypotheses and this indicated the difference in terms of the scopes of the two studies. The previous study investigated the effect of contextual teaching-learning approach on SS 3 students' attitudes to plane geometry while this present study focused on the effect of contextual teaching strategy on attitude and performance in algebraic concepts among senior secondary school II male and female students.

Mtsem (2011) studied the effect of diagnostic and contextual teaching strategy on achievement and interest in algebra among junior secondary school students in Benue State, Nigeria. A sample comprised of 355 JSS 2 students drawn from a population of 10163 junior secondary school two students through stratified random technique from the three randomly selected government-grant secondary schools in the seven (7) Local Government Areas of Benue State Education Zone A was used. The study adopted pre-test and post-test quasi-experimental designs involving two experimental groups and one control group. Two experimental treatments were assigned to two groups− diagnostic approach and contextual teaching strategy, while the control group was taught using the lecture method. Ten research questions and ten null hypotheses were tested at 0.05 level of significance. The instruments used for the study were Algebra Interest Inventory (AII) and Algebraic Achievement Test (AAT) with reliability coefficients 0.68 and 0.84 respectively. The pre-test and post-test results from each approach were collected and then analyzed using ANCOVA. This quantitative study concluded that the group taught using contextual teaching strategy did not only achieve significantly better than those taught using diagnostic approach and lecture method but also developed significantly more interest. The study also indicated that there was no significant difference between the achievement of females and males taught using contextual teaching strategy. The previous study has provided empirical evidence indicating the efficacy of contextual teaching strategy on the interest and achievement of female and male junior secondary students in algebra. In particular, it indicated that contextual teaching strategy had a significant effect on students' achievement in algebraic concepts over those taught using diagnostic and/or conventional approaches and it is gender-friendly.A similar study is still needed in algebra at the senior secondary school level to see if the result can be the same or not.

Mtsem's (2011) study is related to the present study in terms of teaching method, research design, and both of them have some variables such as performance, algebraic concepts, gender, and traditional method in common. However, the two studies differ in several ways: The findings of Mtsem (2011) focused on assessing the relative effect of diagnostic and contextual teaching strategy on two key variables, students' interest and achievement while this present study focused on the effect of contextual teaching strategy on two dependent variables, attitude, and performance, which implies that the study has left an important variable, the students' attitude, that the current study aims at considering in its findings. This indicated a gap that exists between the studies. It was also observed that the previous study implemented a contextual teaching strategy developed by Johnson (2002) while the present researcher implemented the REACT Strategy, a contextual teaching strategy developed by Crawford (2001). The study of Mtsem (2011) was targeted on algebraic concepts at the junior secondary school level and the area of study was in Benue while this study targeted algebraic concepts at the senior secondary school level in Zaria. Hence, the present study investigated the effect of contextual teaching strategy on attitude and performance in algebra among selected public senior secondary school students in Zaria Educational Zone of Kaduna State, Nigeria.

Wendi (2008) used 58 students as a sample from the population of 315 students of the first-grade students of SMAN 1 Ciputat, Indonesia, to find out whether there is any significant effect in speaking achievement of students who are taught using contextual teaching strategy and those who are taught using audio-lingual method (ALM). Two out of eight intact classes (X.8 and X.7) were selected using random sampling technique and both were given treatments. The experimental group which consisted of 29 students was taught with contextual teaching strategy and the rest from the control group was taught using ALM. Using T-test statistics to analyze the data, the findings revealed that the students in the experimental group had better performance than those in the control group. This study also re-emphasized the impact of contextual teaching strategy on students’achievement. Therefore, there is a need to find out its impact on attitude and performance in algebra.

Haki (2012) investigated the effect of the learning cycle versus traditional and contextual versus non-contextual instruction on 11th-grade students' achievement and attitude towards impulse and momentum. The purpose of the study was to explore how contextual and non-contextual instructions contribute to the effective learning cycle and traditional method on 11th-grade male and female students' achievement in "impulse and momentum", and attitude towards physics. A sample of 226 (105 female and 121 male) was drawn through the purposive sampling technique from all the11th grade high school science majors in Etimesgut, Ankara-Turkey. The study adopted a 2x2x2 factorial experimental design with eight treatment groups formed from the combination of the three independent variables, contextual vs. non-contextual instructions; learning cycle vs. traditional method, and gender. Two instruments used in the study were: Impulse and Momentum Achievement Test (IMAT) and Affective Characteristics Questionnaire (ACQ). Six hypotheses that guided the study were tested at 0.05 level of significance. The descriptive statistical tools, multivariate analysis of covariance (MANCOVA), and analysis of covariance (ANCOVA) were run to test the 6 hypotheses raised in the study. The results revealed that:

1. There is a significant difference between mean combined scores of quantitative achievement, conceptual achievement, and attitude of the students in contextual and non-contextual groups in favor of the contextual groups.
2. There are no significant differences observed between the groups with the learning cycle and the traditional method.
3. The contextual approach was more effective in supporting students' conceptual understanding of impulse and momentum.
4. The contextual approach worked better with the traditional method than the learning cycle for achievement and attitude.
5. Males benefitted a little more from the learning cycle while females benefitted a little more from the traditional method in terms of conceptual and non-conceptual scores.
6. In terms of quantitative and conceptual achievement, males benefitted little more from contextual-based instruction while females benefit little more from non-contextual instruction.

The study of Haki (2012) is similar to the present study as both of them have some variables in common but differ in the sense that Haki’ (2012) study was based on the effect learning cycle/ traditional method with contextual-based instruction on combined dependent variables of quantitative achievement, conceptual achievement, and attitude while the present study investigated the effect of contextual teaching strategy in isolation on attitude and performance. A 2x2x2 factorial experimental design was adopted in his study while the present study will employ a pre-test, post-test non-equivalent control group quasi-experimental design. The study was carried out in physics and the area of the study was Ankara-Turkey. The present study focused on algebraic concepts and the area of study in Zaria, Kaduna State-Nigeria.

Sunar (2013) investigated the effect of context-based instruction integrated with the learning cycle model on students’ achievement and retention related to states of matter subject in Bursa metropolis of Ottoman state, Turkey. The study aimed to explore the effectiveness of context-based instruction integrated with the learning cycle model as compared to the traditional instruction on tenth-grade students’ achievement and knowledge retention on the states of matter subject and their attitudes toward chemistry. The study adopted a quasi-experimental pre-test post-test control group research design. A sample of 150 tenth grade students comprising 71 boys and 79 girls from two randomly selected Anatolian high schools in Bursa metropolis of Ottoman state, Turkey was used for the study. Twelve (12) research questions and twelve (12) null hypotheses were tested at 0.05 level of significance. The instruments used in the study were the State of Matter Achievement Test (SMAT) and the Affective Characteristics Questionnaire (ACQ). Data obtained from this study were analyzed with descriptive analysis and inferential analysis in the form of mean, standard deviation, ANCOVA, and MANCOVA. The results of the findings revealed that:

i. Students taught states of matter using context-based instruction integrated with the learning cycle model had significantly higher performance scores and better knowledge retention;

ii. Students who received context-based instruction developed better attitudes to chemistry than those taught with the traditional instruction;

iii. There was no significant effect of teaching-gender interaction on student performance on the state of matter subject;

iv. There was no significant interaction effect between instruction and gender on their attitudes to chemistry and their retention of knowledge about the states of matter;

v. While the interaction effects are not significant, male students appear to benefit more from the context-based teaching in terms of developing more positive attitudes toward chemistry.

Sunar's (2013) study provided empirical evidence that context-based teaching not only affects student performance and attitudes, as seen in earlier findings, but it has a significant impact on retention as well.

Another study conducted by Ahmad (2017) shared almost similar aims with the study of Sunar's (2013) on a different chemistry subject;to explore the impact of context-based instructional approach on students' academic achievement and retention of hydrocarbon concepts among science secondary students in Kano State, Nigeria. The population of the study was all the science secondary schools in Kano State. The sample size of 120 SS 2 students comprising of 60 males and 60 females was drawn from the population through stratified random technique. The study adopted pre-test and post-test quasi-experimental designs involving one experimental group and one control group. The experimental group was exposed to a context-based approach while the control group was taught using the lecture method. Three research questions and three null hypotheses were tested at 0.05 level of significance. The instrument used for the study was the Chemistry Achievement Test (CAT) with reliability coefficients of 0.85. The pre-test and post-test results from each approach were collected and then analyzed using t-test analysis. This quantitative study concluded that the group taught hydrocarbon concepts using a context-based approach did not only achieve significantly better than those taught using the lecture method but also retained the learned concepts better as well. The study also indicated that there was no significant difference between the achievement of females and males taught using a context-based approach.

A similar effort was made also by Elmas and Geban (2016) in Ankara, Turkey, with a sample of 222 ninth-grade students comprising 107 boys and 115 girls from two randomly selected Public and Anatolian high schools in the Etimesgut district of Ankara, Turkey.The purpose of this study was to examine the effect of context-based chemistry instruction on 9th-grade students’ understanding of cleaning agents' topics and their attitude toward the environment in Ankara, Turkey. The study adopted the pretest and post-test, quasi-experimental design. Four.hypotheses were also formulated and tested at 0.05 level of significance. The instruments used were the Cleaning Agents Achievement Test (CAAT), Science Process Skills Test (SPST), and the Attitude toward Environment Scale (ATES). Data obtained from this study were analyzed with descriptive analysis and inferential analysis in the form of mean, standard deviation, and two-way multivariate analysis of covariance (MANCOVA). The results of the analysis revealed that the experimental group had significantly higher performance scores in chemical concepts than the students in the control group. However, no significant difference was reported concerning the mean scores of students on the attitude toward environment scale, and outcomes of students did not differ in terms of school type.

Ilhan et al. (2010) applied a mixed-methods research design including both quantitative and qualitative data analysis;to explore the effectiveness of Context-Based Chemistry Course (CBCC) as compared with traditional/existing instruction, on 11th-grade students’ learning about chemical equilibrium, ‘motivation to learn chemistry’ and ‘constructivist learning environment’.The study group consisted of 104 eleventh grade students drawn through the purposive sampling technique from all the 11th-grade high school science majors in Etimesgut, Ankara-Turkey. Four research questions and four null hypotheses were tested at 0.05 level of significance. The instruments used for the study were Chemical Equilibrium Achievement Test (CEAT), Chemistry Motivation Questionnaire (CMQ), and Constructivist Learning Environment Survey (CLES) with reliability coefficients 0.70, 0.84, and 0.89 respectively were used for quantitative data collection (as pre-test and post-test). For the quantitative part of the study, a quasi-experimental pre-test-post-test control group design was utilized for a 7-week treatment. The dependent variables of the study were determined as achievement, motivation, and contribution of context-based instruction to the constructivist learning environment. Two classes were randomly selected from four intact classes as the experimental group and they received context-based instruction while the rest were carried on with their traditional instruction. Quantitative data were collected using Chemical Equilibrium Achievement Test, Chemistry Motivation Questionnaire, and Constructivist Learning Environment Survey. For the qualitative part of the study, the data were collected through interviews with teachers and Student Opinion Questionnaire. The quantitative study concluded that the group taught chemical equilibrium using context-based instruction did not only achieve significantly better than those taught using traditional instruction but also highly motivated to learn chemistry. The study indicated that context-based instruction contributed more to the constructivist learning environment. Students’ opinions on the implementation of CBCC showed that CBCC provided authentic applications of chemistry topics, formed relations between chemistry and daily life, concretized chemistry concepts, made concepts highly memorable, and learning more enjoyable in the courses. The interviews conducted with teachers implementing context-based instruction in the experimental group revealed that teachers had positive feelings towards context-based instruction. In summary, results showed that CBCC, compared to traditional/existing instruction, enabled students to learn chemistry concepts more effectively.

Taylor and Mulhall (2000) studied contextualizing teaching and learning in rural primary schools using agricultural experiences. The study aims to examine how agriculture could be used as a means of contextualizing the primary school mathematics curriculum in rural areas. The study was carried out in four countries, Tanzania, Sri Lanka, India, and Ethiopia. Data collection from each country was through informal, semi-structured interviews and three participatory activities, namely order ranking, matrix ranking, and mapping. Separate questionnaires were constructed for the head-teacher, teachers (2 groups of 4 teachers per school), pupils (group interviews of 6 - 8 per group), and community members (group interviews of 4 - 6 per group). Matrix ranking, which involved ranking ten methods of learning against each other by preference, was undertaken by pupils and teachers. Data collected were analyzed with t-test and regression analysis. The findings indicated that contextualized mathematics education: remediated students’ misconceptions; motivated their interest towards mathematics and boosted not only the students’ attitudes towards mathematics but also the teachers and parents had very positive attitudes towards the teaching and learning activities associated with the curriculum materials. The findings also revealed that there was no significant relationship between the male and female students in terms of attitudes towards mathematics.

From the review, it could be noted that no or not much work on the effect of contextual teaching strategy (CTS) on students' performance and attitude in algebraic concepts have been carried out in Nigeria, hence, the effect of contextual teaching strategy on students' performance and attitude in algebraic concepts at the senior secondary level is yet to ascertain. The researcher framed this study based on the previous research. However, this study is different in the aspect of Contextual Teaching Strategy that was applied (REACT Strategy) and the level of education used⎯ Senior Secondary School. With some degree of confidence, the use of contextual teaching strategy (CTS) could be of the effective teaching strategies that can significantly improve students’ performance in algebraic concepts in particular as well as mathematics in general as observed from the literature review.

**2.9 Implications of Literature Reviewed on the Present Study**

The literature reviewed up to the present time has given some clear perceptions into the effect of contextual teaching strategy on attitude and performance, and this has some implicationsfor the study. From the literature reviewed so far, there are obvious indications that the in-class visual and hand-on demonstration, group interaction, inquiry group among others couple with the significant activities contained within the instructional package such as solving real-life problems, conducting quizzes, and so on, could be a good means of attracting students’ interest in a topic, stimulate their participation and provide the opportunity of identifying their misconceptions and above all, the strategy could get the students rid of abstractness and difficulty in learning that usually cripples their performance in their standardized examination. It is because of these advantages that this study is being conducted.

The general mathematics syllabus is specifically designed to equip the students with the understanding of mathematical concepts, ideas, theorems, basic assumptions logical structures, abstract symbolism, and their wide applications to everyday lifestyle. All these cannot be achieved with an ineffective teaching method. In Nigerian mathematics classrooms, the most common instructional method of teaching is the lecture method. This method has been identified as an ineffective method, unproductive, unsuitable, and that it has no potential for meaningful learning. As a result, problems like misconceptions, lack of understanding of the basic concept in different contexts, and so on, cannot be overcome by this method.

The literature review has identified contextual teaching strategy as a strategy for improving students’ basic skills acquisition, that is a strategy that allows students to acquire knowledge rather than to memorize facts; a strategy that has the potential to motivate and effectively engage students who view mathematics as a boring or difficult subject, or who have struggled to make the connections between the demands of the classroom and their personal goals and aspirations. This is because, through the process, students gain first-hand experiences from the in-class hand-on experiences which include the use of manipulative that can be moved around to model mathematical concepts concretely and problem-solving activities that engage students’ creativity while they are learning key concepts.

From the empirical evidence cited in this study, several works have been done on contextual teaching strategy in art, sciences, and engineering in countries like Malaysia, Brazil, Indonesia, America, and so on, considering variables such as performance, interest, cognitive abilities, motivation, problem-solving skills, scientific attitude and gender with a few record of it in Mathematics. No studies investigated the effect of contextual teaching strategy (REACT Strategy) to the best of my knowledge on attitude and performance in algebraic concepts among senior secondary school II male and female students in Nigeria. Only a few studies have investigated the effect of REACT Strategy and the field of study in chemistry, biology, or physics. An example is a study of (U¨ltay, 2012a) whose finding was on the effect of conceptual change text (CCT) in the REACT strategy for students’ conceptions of solutions (acids and bases). Therefore the review of related studies has highlighted the importance of the need for research study in the area of mathematics. In the present study, a thorough investigation was made on the effect of REACT Strategy on attitude and performance in algebra considering senior secondary school two students as appropriate subjects for the study because most of the algebraic topics that will be covered at this level were those identified and reported by WAEC Chief Examiner (2012), as some of the areas senior secondary students find difficult and which led to the present dismal performance of students in mathematics at the Senior School Certificate Examination (SSCE).

Apart from the inappropriate teaching method employed by the senior secondary school teachers, gender disparities, students’ attitudes towards learning mathematical concepts and academic performance are among the major issues, problems, and challenges identified in the literature review. However the awareness of contextual teaching strategy, by teachers, as an approach to teaching mathematics in which one can design a learning environment that incorporates many different forms of experiences and satisfies the criteria; that it would: make algebraic concepts appear concrete to students;require minimum prerequisite algebraic skills;be perceived as sensible and non-arbitrary to students;connect concepts to the broader context of use; be useable directly by students as a method for test situations, will enable them to understand how common students’ constraints such as students’ common conception of algebra as being “abstract”; students’ lack of pre-requisite algebraic skills; students’ anxiety; girls lack confidence in doing mathematics and so on be addressed. It is to this note that the researcher intends to investigate the effect of contextual teaching strategy (REACT Strategy) on attitude and performance in algebra among senior secondary school students in some randomly selected public secondary schools in Zaria Educational Zone of Kaduna State, Nigeria.

**CHAPTER THREE**

**RESEARCH METHODOLOGY**

**3.1 Introduction**

This chapter contained the procedure and instruments designed to investigate the effect of contextual teaching strategyon the attitude and performance of senior secondary school students towards algebraic concepts. The chapter is presented under the following subheadings:

3.2 Research Design

3.3 Population of the Study

3.4 Sample and Sampling Procedure

3.5 Instrumentation

3.6 Validity of the Instruments

3.7 Pilot Study

3.8 Reliability of the Instruments

3.9 Item Analysis

3.10 Procedure for DataCollection

3.11 Administration of Treatment

3.12 Procedure for Data Analysis

**3.2 Research Design**

The study used a quasi-experimental design involving two groups, the experimental and control groups, to investigate the effect of contextual teaching strategy on the attitude and performance of senior secondary two students towards algebraic concepts. The adopted design was employed because the subjects of this study were in intact classes and this implies that random assignment of subjects to conditions may not be possible. The design is viable as confirmed by Ali (2006) that subjects are not aware of an experiment being conducted when intact classes are used than when they are randomly selected from their various classes and put into experimental sessions. Thus, the effects of experimentation are more easily controlled.

In the first stage, a pre-test was administered to all the subjects from both the experimental and control groups. After this, the experimental group was subjected to contextual teaching strategy (CTS) while their counterpart in the control group was taught the same algebraic concepts with the lecture teaching method. At the end of the treatment period, the post-test was administered to both groups to evaluate the efficacy of the treatment. The research design is presented in figure 3.1.

O1(ACPT&ACAQ)

O2(ACPT&ACAQ)

X1

EG

OA

OA

OA

O2(ACPT&ACAQ)

O1(ACPT&ACAQ)

CG

X0

**Figure 3.1: Research Design Illustration**

**Key:** EG- Experimental group

CG- Control group

O1- Pre-test

O2- Post-test

X1- Treatment

X0- Control

ACPT-Algebraic Concepts Performance Test

ACAQ- Algebraic Concepts Attitude Questionnaire

**3.3 Population of the Study**

Kaduna State Ministry of Education has a total number of twelve (12) Zonal Education Offices. These are Anchau, B/Gwari, Giwa, Godogodo, Kachia, Kaduna, Kanfanchan, Lere, Rigachikun, Sabon Tasha, Zaria, and Zonkwa Zonal Education which serve as the parent population for the study. But the target population of this research exercise isthe Zaria Zonal Education Office which has a total number of 49 public secondary schools that are categorized into three:

1. Re-articulated (both junior and senior) public secondary schools;
2. Public senior secondary schools; and
3. Public junior secondary schools.

These schools cut across five local government areas of Kaduna State: Zaria, Sabon Gari, Zoba, and some parts of Kudan and Giwa respectively. The accessible population of this study was all the senior secondary two (SSII) students from the re-articulated public secondary schoolsand the public senior secondary schools in the zone. There were twenty-nine (29) established public secondary schools in these two categories with a total number of 6444 SSII students (3713 males & 2731 females). These schools were a mixture of nineteen (19) co-educational and ten (10) single-sex schools. SSII students were chosen for this study because the algebraic concepts that the study covered are in the SSII scheme of work. Details of the population distribution of the schools are presented in Table 3.1.

**Table 3.1: Population of the Study**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| S/N | Name of School | Status | Category | M | F | Total |
| 1. | Alhudahuda College | Single | Re-articulated | 481 | - | 481 |
| 2. | Barewa College | Single | Re-articulated | 426 | - | 426 |
| 3. | SSS Kufena | Single | Re-articulated | 179 | - | 179 |
| 4. | GSS Zaria | Single | Senior Sec. Sch. | 389 | - | 389 |
| 5. | GSS Chindit | Single | Senior Sec. Sch. | 374 | - | 374 |
| 6. | GGSS Chindit | Single | Senior Sec. Sch. | - | 307 | 307 |
| 7. | GGSS D/Bauchi | Single | Senior Sec. Sch. | - | 475 | 475 |
| 8. | GGSS Pada | Single | Senior Sec. Sch. | - | 250 | 250 |
| 9. | GGSS (Kongo) Zaria | Single | Re-articulated | - | 303 | 303 |
| 10. | GGSS K/Gayan | Single | Re-articulated | - | 375 | 375 |
| 11. | GCC Zaria | Co-educational | Re-articulated | 28 | 30 | 58 |
| 12. | GSS Aminu | Co-educational | Senior Sec. Sch. | 156 | 92 | 248 |
| 13. | GSS Awai | Co-educational | Re-articulated | 24 | 1 | 25 |
| 14. | GSS Bogari | Co-educational | Re-articulated | 21 | 3 | 24 |
| 15. | GSS Dakace | Co-educational | Re-articulated | 152 | 66 | 218 |
| 16. | GSS Dinya | Co-educational | Re-articulated | 24 | 3 | 27 |
| 17. | GSS Gyalesu | Co-educational | Re-articulated | 204 | 121 | 325 |
| 18. | GSSSKaura | Co-educational | Senior Sec. Sch. | 213 | 118 | 331 |
| 19. | GSS K/Kuyanbana | Co-educational | Re-articulated | 157 | 54 | 211 |
| 20. | GSS Kugu | Co-educational | Re-articulated | 61 | 16 | 77 |
| 21. | GSS Likoro | Co-educational | Re-articulated | 41 | 11 | 52 |
| 22. | GSS Magajiya | Co-educational | Senior Sec. Sch. | 117 | 43 | 160 |
| 23. | GSS Muchia | Co-educational | Senior Sec. Sch. | 182 | 146 | 328 |
| 24. | GSS T/Jukun | Co-educational | Re-articulated | 102 | 161 | 263 |
| 25. | GSS T/Saibu | Co-educational | SeniorSec. Sch. | 127 | 23 | 150 |
| 26. | GSS Richifa | Co-educational | Re-articulated | 44 | 6 | 50 |
| 27. | GSS Yakasai | Co-educational | Re-articulated | 43 | 11 | 54 |
| 28. | SIASSS K/Karau (A) | Co-educational | Re-articulated | 67 | 6 | 73 |
| 29. | SIASSS K/Karau (B) | Co-educational | Re-articulated | 109 | 110 | 219 |
|  | **Total** |  |  | **3713** | **2731** | **6444** |

**Source:**Kaduna State Ministry of Education, Zaria Zonal Education Office (2017)

**3.4 Sample and Sampling Procedure**

The sampling technique adopted for this study was stratified random sampling since some variables have to be considered. The technique according to Razaq andAjayi (2000) can be used when the population is classified according to desired characteristics of the population such as sex, age group, location, school type, nationality, religious affiliation, social-economic group, and so on. Eachgroup called stratum is then sampled as an independent sub-population, out of which the required sample from that particular stratum can then be randomly selected. The groups or strata that exist in the study population were the school status (co-educational and single-sex schools) and category (the re-articulated public secondary and public senior secondary schools). To cater for all the characteristics mentioned, all the 19 co-educational schools from the two major categories of schools in the zone were first selected as the sample frames- made as independent sub-populations. The choice of the co-educational schools was to avoid sampling bias since the study involves gender testing/difference. To obtain a sample for the study from these two identified sample frames, the proportion of co-educational schools in the two frames to the total numbers of all co-educational schools in the population was used to select at random, using simple balloting method, two schools. From the two schools, one school was randomly assigned as the experimental school and the other as the control school. One intact class from the SSII arm was randomly selected from each of the two schools.The sample size for the study is one hundred and thirty-three (133) SSII students. The sample size is worthwhile for an experimental study as pointed out by Fraenkel and Wallen (2007) a sample of a minimum of 30 subjects is viable for experimental study. The detail of the sample is presented in Table 3.2.

**Table 3.2: Distribution of the students’ sample**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| N | Name of School | Grouping | Enrolment  M F | | Total |
| 1. | School A | Control | 33 | 32 | 65 |
| 2. | School B | Experimental | 34 | 34 | 68 |
|  | **Total** |  | **67** | **66** | **133** |

The criteria for selecting public schools from this zone were:

1. All the schools are owned by Kaduna State Government.
2. The teachers were recruited and posted by the Kaduna State Teachers’ Service Boards.
3. Students were admitted by the same body throughout the state using criteria that include good performance in the state-administered entrance examination for selecting candidates for admission.
4. All public schools in the zone utilize the same mathematics curriculum approved by the Kaduna State Ministry of Education.

These criteria were considered to have subjects with similar educational backgrounds and homogeneity.

**3.5 Instrumentation**

The research involved the construction of two instruments were used for the data collection. These are:

1. Algebraic Concepts Performance Test (ACPT); and
2. Algebraic Concepts Attitude Questionnaire (ACAQ).

**3.5.1 Algebraic Concepts Performance Test (ACPT)**

The ACPT was forty (40) item multiple-choice questions in algebraic concepts based on the curriculum of the SSS II mathematics approved by the Kaduna State Ministry of Education. It is a test constructed by the researcher to measure students’ academic performance in the algebra topics covered by this study. ACPT has two sections: Section A is meant for collecting students’ biodata and section B is the multiple-choice questions on algebraic concepts, which will be used for the pre-test and post-test. In each question, there is only one correct answer (one key) and four distracters, and each correct response was scored 2 marks while the incorrect or no response was awarded zero (0). The instrumentas well as its marking scheme is presented in Appendix 1. Specification of items used in the study is presented in Table 3.3.

**Table 3.3: Item Specification for ACPT**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| S/N | Topic | Kn | Co | Ap | An | Sy | Ev | Total | Wg% |
| 1. | Simplification of algebraic expressions | 1,2 | 3,4,8 | 10 |  |  |  | 6 | 15 |
| 2. | Quadratic expressions (Factorization) | 12 | 5,6,7,9,11,13,14,16,17,21,22,23,25 |  | 15,24 | 20 | 30 | 18 | 45 |
| 3. | Algebraic fractions, special trinomials, and word problems |  | 26,27,18,28,38 | 19,29 |  |  |  | 7 | 17.5 |
| 4. | Solutions of quadratic equations  **Total** | 39,40  **3** | 31,32,33,34,35,36,37  **27** | **3** | **2** | **1** | **1** | 9  **40** | 22.5  **100** |

Source: Adapted from Bloom (1956)

Table 3.3 indicates items specification of Algebraic concepts performance tests and their allocations based on Bloom’s Taxonomy of Cognitive Domain.

Key: Wg%=the weight assigned to the topics, Kn= Knowledge, Co = Comprehension, Ap= Application, An = Analysis, Sy= Synthesis and Ev= Evaluation.

**3.5.2 Algebraic Concepts Attitude Questionnaire (ACAQ)**

The Algebraic Concepts Attitude Questionnaire (ACAQ) was a research-designed structured questionnaire based on a 5-point Likert scale rating. It is adapted by the researcher to determine the attitudinal change in the students’ behavior after being exposed to the treatment. ACAQ contains 40 items, each of which was rated on 5-point scale of Strongly Agree = 5, Agree = 4, Undecided =3, Disagree = 2, and Strongly Disagree = 1. See Appendix 2. Specification of items used in this study for ACAQ is presented in Table 3.4.

**Table 3.4: Item Specification for ACAQ**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| S/N | Sub−Level | Level of affective Domain | | | | | Total | Weight  in % |
| **Rec** | **Res** | **Val** | **Org** | **Char** |
| 1. | Feeling | 10 | 0 | 0 | 0 | 0 | 10 | 25 |
| 2. | Confidence | 0 | 10 | 0 | 0 | 0 | 10 | 25 |
| 3. | Beliefs | 0 | 0 | 10 | 0 | 0 | 10 | 25 |
| 4. | Behaviors | 0 | 0 | 0 | 4 | 6 | 10 | 25 |
| Total |  | 10 | 10 | 10 | 4 | 6 | 40 | 100% |

Source**:** Adapted from Bloom (1956)

Key:Rec→ Receiving, Res → Responding, Val → Valuing, Org → Organization, Char → Characterization.

**3.6 Validation of Instruments**

The validations of the instruments are discussed as follows:

**3.6.1 Validation of Algebraic Concepts Performance Test (ACPT)**

The drafted sample questions were distributed to three senior lecturers witha Ph.D. qualification in the Department of Science Education, Ahmadu Bello University, Zaria, for validation. The experts modified the instrument based on content and face validity. Factors scrutinized include:

1. Conformity of the test item with the subject specification.
2. Content clarity and appropriateness of the items in terms of students’ ability
3. Content validity of the test item in terms of the content and objectives.

Based on the critique and suggestions from the experts' amendments were made.For example, it was suggested by the experts that test item that does not match the objectives of a particular section of the ACPT should be moved to its appropriate section. In response to this, question 38 was moved from section 4 to 3. The number of test items in each section of the instrument was not equal before the validation. So, a suggestion was made by the experts to construct an equal number of items which as a result then led to the amendment of not only the instrument but also the item specification. The instruction on the instrument reads as follows: answer all questions. To correct this, the experts suggested that answering all the questions by ticking or circling the correct answers will be appropriate. All the observations, remarks, and corrections made by the experts were adjusted. Adherence to the modification made by the experts makes the instruments suitable for the pilot study. Initially, there were 60 questions but only 40 were retained after validation.See appendix I.

**3.6.2 Validation of Algebraic Concepts Attitude Questionnaire (ACAQ)**

Test for Algebraic Concepts Attitude Questionnaire (ACAQ) was adapted from Deopkan, Lawsky, and Padwa (2013). Though the original instrument was modified by the experts; it has been revalidated by three senior lecturers with a Ph.D. qualification in the Department of Science Education,Ahmadu Bello University, Zaria. The Algebraic Concepts Attitude Questionnaire experts gave both face and content validity to the questionnaire. Most of the test items in the instrument were found satisfactory and met validation requirements. Nevertheless, their suggestions led to the elimination of ambiguous words and reframing of inappropriate statements in item 6 where the researcher wrote ‘I find algebra scary’, the researcher was advised to use a simpler statement, and as such the item was revised. The experts also advised the researcher to include the phrase ‘to me’ in items 22, 26, 27, and 30, for example, item 30 was initially ‘Algebra is of no relevance to our everyday activities but it was suggested to be written as ‘Algebra to me is of no relevance to our everyday activities. In response to these adjustments, 8 items out of the 48 items of the ACAQ in the initial draft were discarded while the remaining 40 items were retained after validation. See appendix I.

**3.7 Pilot Study**

A pilot test was carried out with thirty (30) students of SSII at Demonstration Secondary School, Ahmadu Bello University, Zaria which falls outside the group of not 49 public secondary schools in Zaria Educational Zone ( representing the study population ). The purpose is this pilot test was to assess the suitability of both the Algebraic Concepts Performance Test (ACPT) and Algebraic Concepts Attitude Questionnaire (ACAQ). Following that the Data obtained the the pilot test underwent analysis utilizing Pearson Product-Moment Correlation Coefficient (PPMC). The pilot testing aimed to achieve the following objectives:

1. To evaluate the reliability of the Algebraic Concepts Performance Test (ACPT) and Algebraic Concepts Attitude Questionnaire (ACAQ).
2. To examine the items analysis characteristics of Algebraic Concepts Performance Test (ACPT).
3. To determine the appropriateness of the required test duration .
4. To assess the clarity of the items of ACPT and ACAQ.
5. To identify any challenges or difficulties that may arise during the administration of the instruments.

**3.8 Reliability of the Instruments**

The reliabilities of the instruments are discussed as follows:

**3.8.1 Reliability of Algebraic Concepts Performance Test (ACPT)**

The reliability of the Algebraic Concepts Performance Test (ACPT) was assessed through a test-retest method involving the administration of two separate tests to students with a two-week interval as recommended by Tuckman (1975). Subsequently, the results from both tests administrations were correlated using Pearson Product-Moment Correlation Coefficient (PPMC) yielding a reliability coefficient of 0.82. This coefficient indicated a strong positive correlation between the initial and subsequent ACPT administration, affirming the test’s reliability and suitability for data collection in the study. See Appendix E.

**3.8.2 Reliability of Algebraic Concepts Attitude Questionnaire (ACAQ)**

The ACAQ’s reliability was determined using the split-half reliability method. It involved administrating the ACAQ once and then diving the responses into two halves (even and odd items) for scoring. The relationship between these two sub-scores was established using Pearson Product-Moment Correlation Coefficient (PPMC) technique. Razaq and Ajayi (2000), noted that the correlation coefficient derived from such scores measures the internal consistency of the two halves of the instrument while the reliability coefficient (rxx) of the entire test is computed using the Spearman-Brown formula. Following these procedures, the reliability coefficient of ACAQ was found to be 0.76. This result indicated that the ACAQ instrument was reliable as confirmed by Adesokan (2003) that an instrument is considered reliable if its rxx falls between 0 and 1 and that the closer the calculated reliability coefficient is to zero, the less reliable is the instrument, and the closer the calculated reliability coefficient is to 1, the more reliable is the instrument. Consequently, the ACAQ can be considered reliable and suitable for the study. See Appendix F.

**3.9 Item Analysis of ACPT**

To standardize the instrument, an item analysis was carried out. Sambo (2005) defines item analysis as a process that examines the students' responses to individual test items to assess the quality of those items and the test as a whole. Item analysis is especially valuable in improving test items by amending or eliminating ambiguous/ misleading items before using them astests. Hence item analysis was conducted on the data generated from the pilot study to determine the facility and difficulty indices of the items in ACPT.

**3.9.1 Facility Index (FI) of ACPT**

The facility index otherwise known as the Difficulty index of a test according to Wood (1990) is the percentage of students that got an item right. It is determined by using the formula:

FI= × 100,

Where: FI = facility index,

R = number of correct responses,

T = total number of students.

According to Sharma (2019), a facility index within the range of 20% ̶ 80% is considered acceptable and recommended in educational studies. Moreover, Adesokan (2003) suggested that the moderate level of facility index should be within the range of 40% ̶ 60%. In this study, however, Sharma's(2019) recommendation was adopted. Items in ACPT with facility index within the range of 20% ̶ 80% were selected for the study. Items below 20% and above 80% were discarded because the lower (< 20%) the index, the more difficult, the item, and also the item with the index above 80% is regarded as too simple.

**3.9.2 Discrimination Index (DI) of ACPT**

Discrimination Index is an index used to measure how far a test item distinguishes between high and low-scoring students. The Discrimination Index of ACPT was calculated using scores obtained by the upper 27% and lower 27% of the respondents. The index of the test item is given by:

DI =

Where: DI = Discrimination Index of the item

RU = Number of correct responses in the upper 27%

RL =Number of correct responses in the lower 27%

½N = 50% of the total number of the respondents in the upper and lower 27%

Adesokan (2003) positedthat an item with a higher discrimination index indicates that a large proportion ofthe students got the item correctly because the item is too simple. He stated also that if the discrimination index is zero, it means it is difficult because none of the students got the item and the negative value of the discrimination index indicates that more of the low ability students got the item right. In this study, discrimination ranges from 0 −0.29 weak, 0.30 − 0.70 moderate and 0.70 − 1.00 too high were used to select 30 items since the lower the index, the more difficult the item and the higher the index, the simpler the item.

**3.9.2 Distractorof ACPT**

Distractors are incorrect options in the multiple-choice question (Sharma,2019). They are plausible but incorrect options that are often developed based upon students’ common misconceptions or miscalculations which are intended to distinguish between students who have not yet acquired the knowledge necessary to answer the item correctly from those who understand the content (Shin, Guo & Gierl, 2019). According to Sharma (2019), students’performance depends on how the distractors are designed, and a distractor is considered to be a good distractor when it attracts more examinees from the group of low achievers than the group of high achievers.Distractor index or efficiency (DE) for an item can be determined using the formula:

DE = × 100

Where:

BU =Number of the students in the upper 27% who choose the wrong optionsor fail the test item

BL =Number of the studentsin the lower 27% who choose the wrong optionsor fail the test item

½T = Half of the total number of the entirestudents.

Gajjaret al., (2014) posited that the distractor index is expected to have negative discrimination because it is intended to be plausible for students in the lower group. Hingoro and Jaleel (2012) stated that a negative DE indicates that more examinees in the lower group selected wrong options and as such it is acceptable; a zero DE indicatesthat there is no discrimination between the examinees in the upper and the lower groups and hence the options are questionable. They can either be discarded or improved. A positive DE shows that more examinees in the upper group chose wrong options compared to those in the lower group and these should be amended.In this study, all negative distractor indexes are considered functionally effective and retained while options with zero or positive indexes were discarded.Appendix G presents the distractor index for ACPT.

**3.10 Procedure for Data Collection**

Permission to conduct the research in the selected public secondary schools was sought via an introductory letter from the Department of Science Education, ABU Zaria, to Kaduna State Ministry of Education,Science, and Technology, Zaria Zonal Education Office. The request was granted from the director’s office and subsequently, letters were sent to the selected schools soliciting their cooperations.

Following the necessary approval, the data collection process commenced. This involved a quasi-experimental design with a pre-test administered to all subjects to ensure their homogeneity in attitude and performance before treatments as well as to establish baseline measurement. The treatment phase involved the implementation of the contextual teaching strategy using the REACT strategy developed by Crawford (2001) in the experimental group. The control group on the other hand, received instructions by the research assistant, using the lecture method. During the treatment stages, the subjects from both groups were assigned unique identification numbers from the very first day for confidentiality and facilitation of comparisons between the pre-test and the post-test scores. The treatment period lasted for 6 weeks with each session comprising 45 minutes of instruction per period conducted for 5 periods per week.

Data collection instruments utilized in the study involved the Algebraic Contextual Performance Test (ACPT) and Algebraic Concepts Attitude Questionnaire (ACAQ). The ACPT was marked scored over 100 by awarding two and half (2 ) marks for each correct response, while incorrect or no response received a score zero (0). Pre-test and the post-test scores of the ACPT were then used to assess the students’ academic performance in algebraic concepts. The ACAQ consisted of a structured questionnaire containing both positive and negative items. Each positive item was rated on a 5-point scale: Strongly Agree (5 points), Agree (4 points), Undecided (3 points), Disagree (2 points) and Strongly Disagree (1 point). The negative items were rated in the reverse order. The rating scale aimed to capture the participants attitude before and after the treatment and the data obtained were recorded as their attitude scores. The scores obtained from these two tests were subjected to further analysis.

**3.11 Administration of Treatment**

The study subjects received two different treatments: the contectual teaching strategy and the lecture method. In the experimental group, the researcher employed the contextual teaching method to the algebraic concepts covered in the study. Conversely, in the control group, the research assistant utilized the lecture method to teach the same contents. The subsequent subsections provide a more detailed explanation of the procedural steps taken during each treatment phase.

**3.11.1 Treatment for Experimental Group (Contextual Teaching Strategy Manual)**

The experimental group received treatment session guided by lesson plans in Appendix C. Throughout the learning process,classroom activities were integrated to support continuous assessment. Each period of instruction lasted for 45 minutes. After each lesson, assignments were given and corrections were carried out in the following class, all contributing to the learning process. At the end of the treatment session, ACPT and ACAQ instruments were administered as post-test. Below is the contextual teaching manual followed by a flowchart in figure 3.2, while a detailed lesson planned of the contextual teaching strategy was presented in Appendix C.

**Step 1 Relating**: In the relating phase, the researcher established a connection or correlation between the concept to be learned and the students’ existing life experiences or prior knowledge, through carefully crafted questions or tasks that prompt students to share their ideas, beliefs and, commonly held notions or any other form of experiences.

**Step 2 Experiencing:** In the experiencing phase, the researcher helped the students construct the new algebraic concepts through visual aids and hand-on classroom activities, promoting a more effective and profound understanding of the concepts. These hand-on activities involved the use of manipulative to concretely represent abstract algebraic concepts and engaging students in creative problem-solving tasks while they learned the concepts.

**Step 3 Applying:** At applying phase, students were enlightened on how the concepts they have learned can be put into practical use, addressing the question “why do I have to learn this?”. They were provided and guided with lessons (examples) and class activities that demonstrated how algebraic concepts are applicable in various occupational activities.

**Step 4 Cooperating:** During this phase, students were organized into groups of 3 to 5 individuals and tasked with collaboratively solving problems with the manipulative to reinforce knowledge and foster the development of collaborative skills through sharing ideas, discussions, responses, teamwork and more

**Step 5 Transferring:** In the final stage, students were immediately assigned tasked that required them to apply their newfound knowledge in different situations and contexts. The tasks encompassed exercises involving critical thinking and discussion, problem-solving skills and the practical applications of algebraic concepts.

Relating

Experiencing

Applying

Cooperating

Transferring

**Figure 3.2: Flowchart for Contextual Teaching Strategy.**

Source: (Adapted from Crawford, 2001)

**3.11.2 Treatment for the Control Group**

The teaching session was conducted by the school mathematics teacher who has received guidance from the researcher. The lesson plan outlined in Appendix D was followed throughout the session. The teacher employed lecture (chalk-talk) method to deliver the lessons, with students attentively listening and taking notes After each lesson, assignments were given, and corrections were addressed at the beginning of the following class. Each teaching period lasted for 45 minutes. At the conclusion of the exercise, both the ACPT and ACAQ were administered as post-test to all the subjects in the group..

**3.12 Procedure for Data Analysis**

Four research questions were answered using descriptive statistics in the form of mean, standard deviation, and the null hypotheses formulated in the study were tested at p ≤ 0.05level of significance. The statistical tools used in testing the hypotheses are stated as follows:

Ho1 There is no significant difference between the mean performance of students taught algebraic concepts with contextual teaching strategy and those taught with lecture method. This hypothesis was tested using t-test statistics because it involves two parametric variables.

Ho2 There is no significant difference between the attitudes of students taught algebraic concepts with contextual teaching strategy and those taught with lecture method. This hypothesis was testedusing Mann-Whitney u-test statisticsbecause it involves two non-parametric variables.

Ho3 There is no significant difference between the mean performance of male and female students taught algebraic concepts with contextual teaching strategy.This hypothesis was testedusing t-test statisticsbecause it involves two parametric variables.

Ho4 There is no significant difference between the attitudes of male and female students taught algebraic concepts with contextual teaching strategy. This hypothesis was tested using Mann-Whitney u-test statisticsbecause it involves two non-parametric variables.

**CHAPTER FOUR**

**DATA PRESENTATION, ANALYSIS,AND DISCUSSION**

**4.1 Introduction**

The study investigated the Effects of Contextual Teaching Strategy on Attitude and Performance in Algebra among Secondary School II Students in Zaria, Kaduna State, Nigeria. A total of 133 students were used for the study. The students were classified into experimental and control groups. The first group was subjected to a treatment using contextual teaching strategy, classified as an experimental group while the second/control group was taught with lecture method. In the students' study group, a total of 68 representing 51.1% were taught with the contextual teaching strategy, and the rest 65 students representing 48.9% were taught algebraic concepts with lecture method. A total of 66 representing 49.6% were males and the rest 67 representing 50.4% were females. This shows that both male and female students were well represented. Their academic performance and attitudescores before and after being exposed to both treatments were recorded and analyzed usingthe statistical package for Social Science (SPSS).

This chapter was presented under the following sub-headings:

1. Data Presentation
2. Data Analysis
3. Discussion of Findings

**4.2 Data Presentation**

**4.2.1 Answering Research Questions**

**Research Question 1:** What is the difference between the mean performance of the students taught algebraic concepts with contextual teaching strategy and those taught with lecture method?

The data collected to answer research question one was analyzed with descriptive statistics using mean and standard deviation is presented in Table 4.1

**Table 4.1:Means and Standard Deviations of Algebraic Concepts Performance PosttestScores for the Experimental and Control groups.**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Variable** | **Study groups** | | **N** | **Mean** | **Std. Deviation** | | **Mean difference** |
|  | | Experimental | 68 | 37.09 | 13.55 | 6.06 | |
| Mean Performance | | Control | 65 | 31.03 | 9.92 |  | |
|  | | Total | 133 |  |  |  | |

The results in Table 4.1 revealed that there was a mean difference in the posttest scores of the students in the experimental group and the control group.From their posttestperformance scores, the mean score of 37.09 obtained by the experimental group is higher than that of the control group which is 31.03 with a mean difference of 6.06.

**Research Question 2:** What is the difference between the attitudes of students taught algebraic concepts with contextual teaching strategy and those with lecture methods?

The data collected to answer research question two was analyzed with descriptive statistics using mean as presented in Table 4.2

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Variable** | **Groups** | **N** | **Mean Rank** | **Sum of Ranks** | **Mean Rank Difference** |
| Mean  attitude | Experimental | 68 | 80.61 | 5481.50 | 27.86 |
| Control | 65 | 52.76 | 3429.50 |
| Total | 133 |  |  |

**Table 4.2: Means of Test for Algebraic Concepts Attitude Post-test Scores for the Experimental and Control groups.**

The results in Table 4.2 are the outcomes of the Non-parametric statistics showing that differences exist between the mean attitude posttest scores of students,in favor of the experimental group. The experimental group obtaineda higher mean posttest score of 80.61 while the control group had a lower mean posttest score of 52.76.

**Research Question 3:** What is the difference between the mean performance of male and female students taught algebraic concepts with contextual teaching strategy?

The data collected to answer research question two was analyzed with descriptive statistics using mean as presented in Table 4.3

**Table 4.3: Means and Standard Deviations of Algebraic Concepts Performance Post-test Scores for Male and Female in the Experimental group.**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Variable** | **Gender** | **N** | **Mean** | **Std. Deviation** | **Mean difference** |
|  | Male | 34 | 38.27 | 12.15 | 2.36 |
| Mean Performance | Female | 34 | 35.91 | 14.91 |  |
|  | Total | 68 |  |  |  |

Table 4.3 is the outcome of the descriptive statistics showing that there was no difference between the performance of male and female students taught algebra using contextual teaching strategy. Themale students had a mean score of 38.27 while the female students obtained a mean score of 35.91,implying a mean difference of 2.36.

**Research Question 4:** What is the difference between the attitudes of male and female students taught algebraic concepts with contextual teaching strategy?

The data collected to answer research question two was analyzed with descriptive statistics using mean as presented in Table 4.4

**Table 4.4: Means of Test for Algebraic Concepts Attitude Post-test Scores for Male and Female in Experimental groups.**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Variable** | **Gender** | **N** | **Mean Rank** | **Sum of Ranks** | **Mean Rank Difference** |
| Mean attitude | Male | 34 | 34.65 | 1178.00 | 0.30 |
| Female | 34 | 34.35 | 1168.00 |
| Total | 68 |  |  |

The results in Table 4.4 showed that there is no difference between the mean attitude post-test scores of the male and female students taught algebraic concepts using contextual teaching strategy.Themale students had a mean score of 34.65 while the female students obtained a mean score of 34.35,implying a mean difference of 0.30.

**4.3 Data Analysis**

Four research hypotheses raised in this research were tested and analyzed using inferential statistics as presented in Table 4.5, 4.6, 4.7, and 4.8 respectively. The statistical package for Social Sciences (SPSS) was used in the analysis. All data were tested at a P≤ 0.05 level of significance.

**Null Hypothesis One**

Ho1:There is no significant difference between the mean performance of students taught algebraic concepts with contextual teaching strategy and those taught with lecture method.

To test this hypothesis, the post-test scores of students in the experimental and the control groups generated through ACPT were subjected tot-test statistics.The summary of the analysis is presented in Table 4.5.

**Table 4.5: Summary of Independent t-test analysis of Mean Post-test Scores of students in the Experimental and Control groups**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Study**  **Groups** | | **N** | **Mean** | **Std. Deviation** | | | | **Mean difference** | **DF** | | **t-cal.** | | **P** | | |
| Experimental | | 68 | 37.09 | 13.92 | | | | 6.06 | 131 | | 2.932 | | 0.004 | | |
|  | |  |  |  | | | |  |  | |  | |  | | |
| Control | 65 31.03 | | | |  | 9.92 |  | |  |  | |  | |  |

\*Significant at P ≤ 0.05, P calculated < 0.05, t computed > 1.96 at df 131

The results in Table 4.5 presents a summary of the independent sample t-test of mean post-test scores of subjects in both groups. From the table,the calculated P-value of 0.004 is less than the stated level of significance set at P≤ 0.05; the computed t-value of 2.932 is greater than the t-critical valueof 1.96 at 131 degrees of freedom, and their mean performances differed by 6.06. The calculated P-value is less than 0.05 indicated that there is a significant difference favoring the experimental group. A significant difference implies a rejection of the null hypothesis. Therefore the null hypothesis which states that there is no significant difference in the performance in the algebra of students taught using contextual teaching strategy and those taught using the lecture method in Zaria, Kaduna state, is hereby rejected.

**Null Hypothesis Two**

Ho2:There is no significant difference between the attitudes of students taught algebraic concepts with contextual teaching strategy and those taught with lecture method.

To test thishypothesis, the mean rank post-test scores of students in the experimental and the control groups for ACAQ were analyzed using Mann-Whitney u-test statistics at P≤0.05 level of significance. The result is summarized in Table 4.6

**Table 4.6: Summary of Mann-Whitney u-test analysis on the difference in the attitudesof students in the Experimental and Control groups**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Groups** | **N** | **Mean**  **Rank** | **Sum of Ranks** | **Mann- Whitney** | **P** | **Remark** |
| Experimental | 68 | 80.61 | 5481.50 | 1284.500 | 0.001 | Significant |
| Control | 68 | 52.76 | 3429.50 |  |  |  |
| Total | 133 |  |  |  |  |  |

\*Significant at P ≤ 0.05level,P calculated < 0.05

The results in Table 4.6 presentsa summary of Mann-Whitney u-test analysis on the difference in the performance of male and female students in the experimental group. The table showed that significant differences exist between themean attitude of students in the experimental and control groups.The calculated P-value of 0.001 is less than the stated level of significance set atP≤ 0.05 and the computed Mann-Whitney test is greater than the Z-scores of4.169 indicating that the difference favors the experimental group. Their mean attitude of 80.61 and 52.76 in the experimental and control groups respectively, implies also a mean difference of 27.86 in favor of the experimental group. Since a significant difference signifies rejection of null hypothesis, thus the null hypothesis states that there is no significant difference between the attitudes of students taught algebraic concepts with contextual teaching strategy and those taught with lecture method in Zaria, Kaduna state, is hereby rejected.

**Null Hypothesis Three**

Ho3:There is no significant difference between the mean performance of male and female students taught algebraic concepts with contextual teaching strategy.

To test this hypothesis,the male and female mean post-test scores in the experimental group for ACPT wereanalyzed using t-test statistics at P≤ 0.05 level of significance.The summary of the t-test analysis is presented in Table 4.7.

**Table 4.7: Summary of Independent t-test statistics on the difference in the performance of Male and Female Students in the Experimental group.**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Gender** | **N** | **Mean** | **Std. Deviation** | **Mean diff.** | **DF** | **t-cal.** | **P** | **Remark** |
| Male | 34 | 37.27 | 12.15 | 2.36 | 66 | 0.717 | 0.476 | Not Significant |
|  |  |  |  |  |  |  |  |  |
| Female | 34 | 35.91 | 14.92 |  |  |  |  |  |

\*Significant at P ≤ 0.05 level, P calculated > 0.05, t-computed < 1.96 at df 66

The outcomes of the Independent sample t-test in Table 4.7 showed that there is no significant difference between the performance of male and femalestudents taught algebraic conceptsusing contextual teaching strategy. According to the independent t-test statistics, the calculated P-value of 0.476 is higher than the stated level of significance set at P≤ 0.05 with the computed t-value of 0.717 lower than the t-critical value of 1.96 at 66 degrees of freedom. These are clear indications that there is no sufficient evidence to reject the null hypothesis. Therefore the null hypothesis which states that there is no significant difference in the performance in the algebra of Male and Female students taught using contextual teaching strategyin Zaria, Kaduna state, is hereby accepted and retained.

**Null Hypothesis Four**

Ho3:There is no significant difference between the attitude of male and female students taught algebraic concepts with contextual teaching strategy.

To test this hypothesis,the male and female mean post-test scores in the experimental group for ACAQ were analyzed using Mann-Whitney u-test statistics at P≤ 0.05 level of significance. The summary of the u-test analysis is presented in Table 4.8.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Gender** | **N** | **Mean**  **Rank** | **Sum of**  **Ranks** | **Mann-Whitney** | **Z-Cal.** | **P** | **Remark** |
|  | Male | 34 | 34.65 | 1178.00 | 573.000` | -0.061 | 0.951 | Not Significant |
| Female | 34 | 34.35 | 1168.00 |  |  |  |  |
| Total | 133 |  |  |  |  |  |  |

**Table 4.8: Summary of Mann-Whitney u-testAnalysis on the difference betweenMean attitudescores of Male and Female Students in the Experimental group.**

\*Significant at P ≤ 0.05, P calculated >0.05

Table 4.8 presented the summary of theMann-Whitneyu-test analysis on the difference between the mean attitude scores of male and female students in the experimental group.From the sample,a u-test analysis P-value of 0.951 was obtained which is greater than the stated level of significance set at P≤ 0.05. This is an indication that there was no significant difference between the attitudes means scores of male and female students taught algebraic concepts with contextual teaching strategyin Zaria, Kaduna state. Thus the hypothesis that states that there is no significant difference between the attitude of male and female students taught algebraic concepts with contextual teaching strategy is hereby accepted and retained.

**4.3.1 Summary of Major Findings**

The findingsof thisstudy were summarized as follows:

1. There is a significant difference between the mean performance of senior secondary school two (SS2) students taught algebraic concepts with contextual teaching strategy and those taught with lecture method in Zaria, Kaduna state. The observed difference and the tested hypothesis are in favor of students exposed to contextual teaching strategy.
2. There is a significant difference between the attitudes of senior secondary school two (SS2) students taught algebraic concepts with contextual teaching strategy and those taught with lecture methodin Zaria, Kaduna state. As indicated by means scores and tested hypothesis, the difference is significant in favor of students exposed to contextual teaching strategy.
3. There is no significant difference between the mean performance of senior secondary school two (SS2) male and female students taught algebraic concepts with contextual teaching strategy in Zaria, Kaduna state. Themale and female studentstaught algebraic conceptsusing contextual teaching strategy do not differ significantly in their ability as indicated by mean scores and tested hypothesis.
4. There is no significant difference between the attitude of senior secondary school two (SS2) male and female students taught algebraic concepts with contextual teaching strategyas indicated by mean scores and tested hypothesis,in Zaria, Kaduna state.

**4.4 Discussion of the Findings**

The objective of this study is to find out the attitude and performance of senior secondary school students two taught algebraic concepts using contextual teaching strategy and those taught using lecture method. Data generated from the administration of the instruments, Algebraic Concept Performance Test (ACPT) andAlgebraic Concepts Attitude Questionnaire (ACAQ), were analyzed according to the research questions and hypotheses earlier stated. The discussion of the result is as follows:-

The descriptive analysis in table 4.1 showed that in comparing the mean performance post-test scores of the students taught using contextual teaching strategy (experimental group) and those taught using lecture method (control group), the senior secondary school two (SS2) students taught algebraic concepts using contextual teaching strategy perform better academically than their counterpart in the control group. This finding showed that contextual teaching strategy was effective in enhancing academic performance in algebra. The finding is supported by previous research for example Mtsem (2011) in Benue Nigeria, Kamaruddin and Amin (2009) in Malaysia, Wendi (2008) in Indonesia, Wiseley (2009) in California USA and Haki (2012) in Ankara-Turkey. All reported the positive effect of contextual teaching strategy on academic performance. The finding of the t-test analysis in table 4.5 also indicated that the calculated P-value is less than the stated level of significance set at P ≤ 0.05 meaning that there is a significant difference favoring the experimental group. According to Mtsem (2011), students taught algebraic concepts using contextual teaching strategies perform significantly higher than those taught using either diagnostic or traditional methods. The reason for this significant difference might be because contextual teaching strategy is an application-oriented approach that helps students acquires knowledge rather than memorize facts. Secondly, it is a context-based approach as it allows the students to learn algebraic concepts within a social and concrete, memorable context, and above all it is a system of instruction that exposes students to several divergent instructional models that actively engages students in the learning processes and activities.

The analysis of the descriptive statistics in Table 4.2 revealed that the students taught algebraic concepts using contextual teaching strategy had higher mean attitude post-test scores than their counterparts in the control group. The significant improvement in students’ attitude was due to the effect of the treatment as suggested by the data. The Mann-Whitney u-test analysis on the difference in the attitudes of students in the experimental and control groups in table 4.6 also confirmed the result in table 4.2. This finding is in agreement with the findings of Komalasari (2012) in Indonesia andHaki (2012) in Ankara-Turkey. The observed significant difference in the attitude of the experimental groups in this study may be attributed to a large extent to the positive learning environment that incorporated many different forms of experience ─ social, cultural, physical (in-class visual and concrete) and psychological, offered by contextual teaching strategy, which gives meaning, relevance and usefulness to learning. Komalasari, (2012) also observed that contextual teaching strategy gave students a kind of learning environment that enabled them to discover meaningful relationships between abstract ideas and practical application in the real world context which in turn helped them see the relevance of the lesson and created a pathway for them to understand the concepts. A typical investigation made by Çigdem, Sadegül, and Sinan (2009) in a qualitative research finding aiming at determining the factors that affect 7th-grade students’ attitudes towards mathematics course indicated that using different materials in teaching and teaching topics with real-life enriched examples were among the major factors that affect students’ attitude positively towards mathematics courses. By implication, contextual-based instruction/strategy is highly effective in enhancing students’ attitudes towards algebraic concepts irrespective of their learning styles.

The result in table 4.3 indicated that there was no gender difference in the effect of contextual teaching strategy in terms of performance. This result agrees with the past findings of Mtsem (2011) in Nigeria and Wiseley (2009) in California USA. The reason for this relationship in terms of performance may be because the linking of classroom mathematics with day-to-day life experiences and using several different learning environments not only makes mathematics fun and easier to understand but it also helps students explore their culture and society during learning which might also bridge the gap between gender. However, the study disagrees with other studies for example Haki (2012) in Ankara-Turkey which reported that there is a significant difference between the performance of male and female students taught physics using contextual-based instruction. The result of his findings revealed that males benefitted little more from contextual-based instruction in terms of quantitative and conceptual achievement. The difference between the performance of male and female students in his study stem from the fact that the study focused on how contextual instructions contribute to the effect of the learning cycle and traditional method on 11th-grade male and female students’ achievement and attitude towards impulse and momentum. So, this result cannot be used to conclude that a significant difference exists between them since the experimental group was not directly exposed to contextual teaching strategy.

The result in table 4.4 indicated that there was no significant difference between the mean attitude post-test scores of the male and female students taught algebraic concepts using contextual teaching strategy. The outcomes of the results in Table 4.8 also confirmed that the variability between the mean attitude post-test scores of the male and female students in the experimental group could be considered not statistically significant because the observed P-value of 0.951 of the sample tests obtained is greater than the stated level of significance set at P ≤ 0.05, which signifies that there was no significant difference between the mean attitude post-test scores of the male and female students in the experimental group. This finding is supported by the findings of Taylor and Mulhall (2000) and Sunday et al. (2021)in Nigeria which revealed that there was no gender difference in the effect of contextual teaching strategy in terms of students’ attitudes towards mathematics.

**CHAPTER FIVE**

**SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS**

**5.1 Introduction**

This chapter summarized the study, concluded, and proffered recommendations based on the outcomes of the study, and in addition, it provides suggestions for further studies on the subject of investigation. The chapter was presented under the following sub-headings:

5.2 Summary

5.3 Major Findings

5.4 Conclusion

5.5 Contributions to the knowledge

5.6 Recommendations

5.7 Limitations of the Study

5.8 Suggestions for Further Studies

**5.2 Summary**

The study investigated the Effects of Contextual Teaching Strategy on Attitude and Performance in Algebra among senior secondary schools students in Zaria, Kaduna State, Nigeria. The study was targeted to address the ugly situation we have been experiencing about the students’ performance in mathematics in our standardized examinations. Related pieces of the literature revealed that a no of reasons/factors has been attributed to have contributed to the student's poor performance in their Senior School Certificate Examinations and that various attempts have been put in place to curtain it but no remarkable success has been made so far. Among the contributing factors, the traditional method of conveying the contents was identified as one of the most persistent and compelling factors besetting students’performance inMathematics in Nigeria. The traditional method of teaching mathematics was marked as ineffective, unproductive, and unsuitable for learning mathematics at the senior secondary school level. It was on this note that the study seeks to investigate the effect of Contextual Teaching Strategy on students’ academic performance and attitudes towards algebra, because of its advantages from the literature.

Theoretically, the study was based on constructivism; the study had four objectives, four researcher questions, and four hypotheses. Related works of literature were reviewed which provides the basis of the existing information about the problem of the study.The literature revealed that Contextual Teaching Strategy enhanced academic performance of students, stimulate students participation at both secondary and tertiary levels in arts, sciences, and engineering subjects/courses with a few records of it in mathematics in countries like Malaysia, Brazil, Indonesia, America and recently in Nigeriabut no study to the best of knowledge addressed students attitude and performance in Algebra together at senior secondary school level in Northern Nigeria. The study was conducted using an interpretable non-equivalent control group quasi-experimental design (a pre-test-post-test design). The study population comprised of all public senior secondary school two (SSII) students in Zaria metropolis with a total number of 6444 students, 3713 male ad 2731 female. The sample size of 133 students was drawn using simple random sampling (balloting method) fromtwo public senior secondary schools, one each from the re-articulated schools and public senior secondary schools that comprised 66 male and 67 female students.

**5.3 Major Findings**

From the results of the study, the following findings were made:

1. There exists asignificant difference in the performance of students taughtalgebraic concepts with contextual teaching strategy compared with their counterparts in the control group in favor of the former.
2. Contextual teaching strategy has a higher effect on students’ attitudes towards algebraic concepts than the students in the control group.
3. Themale and female students taught algebraic conceptswith contextual teaching strategies do not differ significantly in their ability as indicated by mean scores and tested hypothesis.
4. There is no significant difference between the attitude of male and female students taught algebraic concepts with contextual teaching strategies.

**5.4 Conclusions**

From the analysis of the data collected from the study’s hypotheses, the following conclusions were drawn:

1. Academic performance in algebra among senior secondary school can be enhanced using contextual teaching strategy..
2. Contextual teaching strategyhas a positive impact on students' attitudesin algebra.
3. Gender variability does not affect the performance of students taught algebra using contextual teaching strategies. Hence, the contextual teaching strategies is a gender-friendly.
4. The strategy does not affect gender among senior secondary school students concerning changing attitudes towards algebraic concepts.

**5.5 Contributions to the knowledge**

The conducted study established that:

1. Contextual teaching strategy improved academic performance in algebraic concepts at the senior secondary levelin Zaria Educational Zone of Kaduna State, Nigeria.
2. Algebraic Concept Performance Test instrument developed by the researcher can be adopted or adapted by other researchers for a similar study.
3. The study provided a teaching manual that is targeted to give a good hand for adopting and implementing the contextual teaching strategy in the classroom and as well as for other researchers to examine for future studies.
4. The study in addition provides sample teaching models that spell out, in steps, the implementation of contextual teaching strategy to stimulate future studies in mathematics and/or other fields of study. It also gives a sense of direction to both curriculum planners and textbook publishers on how to integrate contextualized activities and materials that connect mathematical concepts toa real-lifesituation.

**5.6 Recommendations**

The following recommendations were made based on the outcomes of this study:

1. Contextual teaching strategy could be adopted, in place of lecture method, as an approach to teaching mathematics at both junior and senior secondary school levels, since the study has shown that the strategy stimulated learning and enhanced performance in algebraic concepts, which have been identified and reported as some of the difficult areas of mathematics for senior secondary school students.
2. The Nigerian Educational Research and Development Council (NERDC) and other stakeholders could sensitize and equip the public and private schoolsmathematics teachersthrough seminar/workshops, conferences,and symposia with the skill needed in implementing the strategy as part of their effort to promote effective mathematical teaching at all levels of educations in Nigeria.
3. Research proof and benefits of Contextual teaching strategy could be made available to the professional research bodies and organizations such as the Mathematical Association of Nigeria (MAN), Science Teachers Association of Nigerian (STAN), etc.; curriculum planners and publishers, so that learning materials such as textbooks, workbooks could be modified to accommodate the five essential forms of learning- the REACT strategy.
4. A framework for implementing Contextual teaching strategy - the REACT strategy, in the teaching of secondary school mathematics contents could be developed for mathematics teachers with the view of providing instructions and guidance on how it can be fully practiced in the classroom.
5. Contextual teaching strategy could be taught at the tertiary institutions as a course to equip them on how to utilize several divergent instructional models to move mathematical ideas away from abstract visualization to concrete and sociallymemorable context.
   1. **Limitations of the study**

This study has some limitations which include the following:

1. The researcher faced challenges with the arrangement made for him by the school authority, particularly, the experimental school; the time allocated was the break period, and the period was insufficient for a daily lesson as the strategy incorporated the use of hands-on objects that required at least one class period per contact. As a result, the treatment period was extended to nine weeks instead of six weeks as planned.
2. The students' attendance at school was another challenge. Their numbers fluctuated from time to time, and at the end of the exercise, some of them were absent in both the experimental and control groups.
   1. **Suggestions for Further Studies**

The following suggestions were made for further studies

1. This study was conducted in Zaria Educational zone of Kaduna Statepublic senior secondary schools using two variables- academic performance and attitude; a similar study could be replicated where necessary to ensure its efficacy on othervariables such as motivation, interest, problem-solving skills abilities,students’ different cognitive abilities,and retention, etc.
2. Similar studies could be replicatedon some other identified areas of mathematics that students find difficult at the senior secondary schools level to determine whether the strategy could be used to address different conceptual mathematical problems.
3. Similar studies could be conducted at other levels of education such as junior secondary school level, colleges, etc.
4. Similar studies could be carried out in other science subjects such as Physics, Chemistry, Biology, and Basic Science as there is no tangle record(s) of any kind of this study being carried out in sciences in Nigeria as at the time of the study.