EFFECTS OF SOCIALIST CONSTRUCTIVIST TEACHING STRATEGY ON ATTITUDE, PERFORMANCE AND RETENTION IN ALGEBRA AMONG JUNIOR SECONDARY SCHOOL STUDENTS, KOGI STATE, NIGERIA

BY

Jimoh, Sadat MOMOH

DEPARTMENT OF SCIENCE EDUCATION

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BY

Jimoh, Sadat MOMOH

B.Sc. (Ed) Mathematics, ABU, ZARIA (1988)
M.Ed (Mathematics) ABU, ZARIA (1994)
P13EDSC9004 (P17EDSC9112)

A THESIS SUBMITTED TO THE SCHOOL OF POSTGRADUATE STUDIES AHMADU BELLO UNIVERSITYIN PARTIAL FULFILLMENT OF THE REQUIREMENT FOR THE AWARD OF DOCTOR DEGREE IN MATHEMATICS EDUCATION IN SCIENCE EDUCATION

DEPARTMENT OF SCIENCE EDUCATION,

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AHMADU BELLO UNIVERSITY,

ZARIA, NIGERIA

MARCH, 2021

DECLARATION

I, Jimoh Sadat MOMOH P13EDSC9004 (P17EDSC9112) declare that this thesis titled "Effect of Socialist Constructivist Teaching Strategy on Attitude, Performance and Retention in Algebra among Junior Secondary School Students in Kogi State, Nigeria" has been carried out by me in the Department of Science Education, Ahmadu Bello University, Zaria. The information used for literature and every other part of the work has been acknowledged in the text and a list of reference has been duly provided. No part of this thesis has been previously presented for another degree or diploma in any institution of learning.

________________________ ____________________

Jimoh Sadat MOMOH **Date**

CERTIFICATION

This thesis titled "Effect of Socialist Constructivist Teaching Strategy on Attitude, Performance and Retention in Algebra among Junior Secondary School Students in Kogi State, Nigeria" by Jimoh Sadat MOMOH P13EDSC9004 (P17EDSC9112) has been read and approved as meeting the requirement governing the award of the degree of Doctor of Philosophy (Ph.D.) in Mathematics Education, Department of Science Education of Ahmadu Bello University, Zaria and is approved for its contributions to knowledge and literary presentation.

__________________________ __________________
Prof. M. Musa Date
Chairman Supervisory Committee

__________________________ __________________
Prof. Y.K. Kajuru Date
Member Supervisory Committee

__________________________ __________________
Prof. C. Bolaji Date
Member Supervisory Committee

__________________________ __________________
Prof S. S. Bichi Date
Head, Science Education Department

__________________________ __________________
Prof. S. Abdullahi Date
Dean, School of Post Graduate Studies

DEDICATION

This thesis is dedicated to the dead, the living and the future Mathematics Educators all over the world for their contributions towards the teaching and learning of Mathematics.

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ABBREVIATIONS

AAQS:	Algebraic Attitude Questionnaire Scale
ACAT:	Algebra Concept Achievement Test
APTA:	Algebra Performance Test A
APTB:	Algebra Performance Test B
ART:	Algebra Retention Test
CAI:	Computer Assisted Instruction
CBTM:	Constructivist Based Teaching Method
CCS:	Community Central School
GCE:	General Certificate in Education
HRSC:	Human Research Science Council
ILS:	Integrated Learning Systems
JSS:	Junior Secondary School.
LGA:	Local Government Area
NCE:	Nigeria Certificate in Education
NCTM:	National Council of Teachers of Mathematics
STEB:	Science and Technical Education Board
TAQ:	Trigonometry Attitude Questionnaire
TAT:	Trigonometry Achievement Test
TRT:	Trigonometry Retention Test
TSC:	Teaching Service Commission
TTM:	Traditional Teaching Method.
U.S.:	United States
WAEC:	West African Examination Council
5Es:	Engage, Explore, Explain, Elaborate, Evaluation.

OPERATIONAL DEFINITIONS OF TERMS

Attitude Questionnaire Scale: It is a standardized instrument used to find out students' interest in Algebra.

Algebra Performance Test: It is a standardized test used to check students' knowledge of Algebra.

Algebra Retention Test: It is a standardized test used to verify students' ability to remember acquired algebraic knowledge after some interval of time.

Attitude Towards Algebra: It refers to students' interest in Algebra.

Socialist Constructivism: It is a teaching strategy that actively involves the teachers and students throughout a given lesson.

Traditional Method: It is a teacher centered method of teaching.

5Es: It involves 5 stages: Engage, Explore, Explain, Elaborate and Evaluates.

ABSTRACT

The study investigated the Effect of Socialist Constructivist teaching strategy on Attitude, Performance and Retention in Algebra among Junior Secondary School Students in Kogi State, Nigeria. The study employed Quasi – experimental and control pre-test and post-test group design. The population comprised all the Junior Secondary School students in Kogi State during 2017/2018 academic session and was 29,433 (14,973 male and 14,460 female). JSS three students were used as the research sample. Multi-stage random sampling technique was used to select a sample size of 169 students (77 male and 92 female) from 8,464 JSS three students (4193 male and 4271 female). two educational zones were selected from eight in Kogi State. Among the mixed-gender secondary schools in selected educational zone, two were randomly chosen for the study. At the secondary school stage, an arm of JSS three was randomly chosen and the total number of students involved was 169 that served as the research sample In the chosen two secondary school in each educational zone, one was meant for experimental group and the other for control group by randomization. Four instruments namely Algebra Performance Test A, Algebra Performance Test B, Algebra Retention Test and Algebraic Attitude Questionnaire Scale were used to collect data for the research. The instruments were used respectively for pre-test, post-test, retention ability and attitudinal change. Algebra Performance Test A, Algebra Performance Test B and Algebra Retention Test consisted of forty-multiple choice questions on algebra content with five options (a, b, c, d, e.). The Algebra content covered included simplification of algebraic expressions, expansion of algebraic expressions, factors and factorization of algebraic expressions, simple equations and world problems on simple equations. Algebraic Attitude Questionnaire Scale consisted of twenty items with four options (Strongly Agree, Agree, Disagree, and Strongly Disagree) in order to elicit students' attitude towards Algebra. 5Es (Engage, Explore, Explain, Elaborate, Evaluate was injected into the study in order to boost socialist constructivist teaching strategy. Test-Retest using Pearson Product moment correlation was used to estimate the reliability coefficients of the instruments that measured performance and retention while Split-halves method using Spearman rank order Correlation Coefficient was used for Attitudinal Scale. The respective reliability coefficients were 0.80 and 0.97 Six research questions and six null hypotheses were analysed in the study. t-test for independent samples and Mann Whitney at significance level of 0.05 were used to carry out the data analyses. The results indicated significant differences in the mean performance, retention and attitudinal change in favour of experimental group. But under the experimental group there were no significance means difference between male and female in terms of attitudinal change, performance and retention. It is recommended that students should constantly practise and revise their algebra lessons, teachers should employ different forms of socialist constructivist teaching strategy in the classroom and schools should encourage seminars, workshops and in-service training for teachers to update their mathematical knowledge. Schools should give prize to outshining mathematics student and should encourage the dull ones not to give up.

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CHAPTER ONE

THE PROBLEM

1.1 Introduction:

The ultimate goal of a good classroom teacher is to see that his students become useful to themselves and the society. This goal entails knowledge of content and methodologies. This is why educational researchers have been investigating the appropriate method that should be used in the classroom so that the learners can be functional in the society. Researchers have been agitating for a shift from traditional method of teaching to constructivist teaching methods.

Lerman (2003) says that constructivism is the dominant view of learning, at least within the mathematics education community. It is not difficult to understand why it offers a theoretical rationale for the desire of most teachers to shift the focus of authority and control from the teacher to the pupils, it offers a justification for mixed-ability classes and individualized learning; the powerful metaphor of children constructing their own knowledge seems to describe the processes which are currently emphasized as thinking mathematically, particularly in problem-solving. Constructivism has been widely adopted because it appears to suit existing approaches to teaching.

Traditionally, assessment in the classroom is based on testing. In this style, it is important for the student to produce the correct answer. However, in socialist constructivist teaching, the process of gaining knowledge is viewed as being just as important as the product. Thus, assessment is based not only on tests, but also on observation of the student, the students' work, and the students' points of view.Tella (2013) shows that environment plays a significant role in the acquisition of and achievement in mathematics. Adaramola and Obamanu (2013) make it clear that constructivist learning strategy has the ability to improve students' cognitive ability in mathematics. Abakpa and Igwue (2013) indicate that mastery learning approach enhanced significant improvement among student's achievement and interest in geometry than conventional teaching approach.

Various studies have shown that traditional method of teaching cannot enhance effective retention and achievement of students in mathematics class. Salman and Ameen (2014) show problem-solving models of instructions could enhance student's academic performance better in bearing word problems than the control group. Anyor and Iji (2014) applying integrated curriculum delivery strategy, students' mathematics achievement and retention is adequately and properly improved upon. Kajuru and Kauru (2014) show that constructivist approach enhanced the performance, achievements and retention ability of students in trigonometry.Constructivist teaching is based on constructivist learning theory (Wikipedia, 2015). The theoretical framework holds that learning always builds upon knowledge that a student already knows; this prior knowledge is called a schema. Since all learning is filtered through pre-existing schemata, constructivists suggest that learning is more effective when a student is actively engaged in the learning process rather than attempting to receive knowledge passively. A wide variety of methods claim to be based on constructivist learning theory. Most of these methods rely on some form of guided discovery where the teacher avoids most direct instructions and attempts to lead the student through questions and activities to discover, discuss, appreciate and verbalize the new knowledge. In the constructivist classroom, students work primarily in groups and learning and knowledge are interactive and dynamic. There is a great focus and emphasis on social and communication skills, as well as collaboration and exchange of ideas. This is contrary to the traditional classroom in which students work primarily alone, learning is achieved through repetition and the subjects are strictly adhered to and are guided by a textbook.

Students' attitude toward the teaching and learning of mathematics is a very important factor in the students' ability to retain and perform effectively in mathematics. The attitude of students, towards Mathematics plays an important role in the learning process. It is a disposition of how one considers Mathematics (Mcleod, 2002) while Muhammad and Syed (2008) was of the view that it is a belief that Mathematics is easy or difficult, a belief that a student is bad or good at Mathematics. Between male and female, no definite pattern on their attitude towards Mathematics. Sometimes positive attitude towards Mathematics is in favour of male, sometimes in favour of female and other time's indifference between male and female. Studies like Vermeer, Boekaerts and Seegers (2000); Casey, Nuttall and Pezaris (2001); Michelli (2013) and Mubeen, Saeed and Arif (2013) claimed that while investigating attitude towards Mathematics, it was found as a male domain. Gugtiotta (2010) revealed that more girls liked Mathematics in fourth grade than boys. But studies like Nicolaidu and Philippou (2003), Adebule (2014) and Ali, Mushtaq, Shah, Raheem (2017) investigated the relationship between attitude and students' achievement and gender differences in attitude towards Mathematics and they found that there was no significant differences between the attitudes towards Mathematics of both genders. Omotosho, Titiloye and Titiloye (2013) regard Mathophobia as a phenomenon which leads students to experience irrational fear of mathematics to the extent they are unable to think about, learn, or be comfortable with the subject.

Hence this study investigated the effect of socialist constructivist teaching strategy on Attitude, Performance and Retention in Algebra among Junior Secondary school (JSS) students in Kogi State, Nigeria.

1.2 Statement of the Problem:

Algebra is a branch of mathematics in which symbols (usually letters) represent unknown numbers in mathematical expression or equations. Topics in Algebra are taught for its usefulness in other branches of mathematics and in generalization of scientific truth. This poses problems to the students during the teaching and learning proces since they have a lot of involvement in algebra during mathematics lessons.

Students' achievement in secondary school algebra classroom has become a matter for increased focus in recent years, as educators endeavour to provide students essential skills for life in the knowledge-based economy of the 21st century. The transition from arithmetic to algebra is a difficult task for the mathematics teacher to handle with care.

WAEC Chief Examiner (2013) reported candidates' inability to interpret the word problems and encouraged teachers to put in more effort at leading the candidates to solving world problems leading to simple algebraic equations. In

2015, WAEC/GCE Mathematics Examination, the Chief Examiner's report indicated that algebra was noted to be a major problem for many, with a significant number being unable to cancel algebraic terms successfully.

In an attempt to solve the problems facing students in learning algebra during mathematics lessons in secondary schools, this study investigated the effect ofsocialist constructivist teaching strategy on Attitude, Performance and Retention in Algebra among Junior Secondary School (JSS) students in Kogi State, Nigeria.

1.3 Objectives of the Study

This studyinvestigated on the effect of socialist constructivist teaching strategy on Attitude, Performance and Retention in Algebra among JSS students in Kogi State, Nigeria specifically withthe following objectives to:

(1) find out the effect of socialist constructivist teaching strategy on attitudinalchanges of JSS students towards the learning of algebra.

(2) assess the effect of socialist constructivist teaching strategy on the retention level of JSS students.

(3) investigate the effect of socialist constructivist teaching strategy on the Performance of JSS students in the learning of algebra.

(4) determine the effect of treatment on gender and attitude of JSS students towards the learning of Algebra.

(5) evaluate the effect of experimenetal strategy on gender and performance of JSS students in the learning of algebra

(6) examine the effect of socialist constructivist teaching strategy on the gender and level of retention of learnt algebra by JSS students.

1.4 Research Questions

The study used the following research questions:

1) What is the effect of socialist constructivist teaching strategy on Attitude of JSS Students in Kogi State towards algebra?

2) Is thera a significant effect of socialist constructivist teaching strategy on the performance of JSS students in Kogi State in the learnt algebra?

3) To what extent the effectof socialist constructivist teaching strategy on the retention level of JSS students in algebra?

4) Does socialist constructivist teaching strategy have gender attitudinal change among JSS students towards the learning of algebra?

5) What is the effect of experimental strategy on gender and performance among JSS studentsin algebra?

6) Is there a gender gap in algebra?

1.5 Null Hypotheses:

The study investigated the effect of Socialist Constructivist teaching strategy on Attitude, Performance and Retention in Algebra among JSS students in Kogi State, Nigeria. Based on this, thefollowing null hypotheses were formulated and tested at 0.05 level of significance.

HO_1: There is no significant difference in the attitudinalchange of students toward algebra after being taught with socialist constructivist teaching strategy.

HO_2: There is no significant difference in the mean performance of students taught with socialist constructivist teaching strategy and those taught with traditional method.

HO_3: There is no significant difference in the mean retention level of students taught algebra with socialist constructivist teaching strategy and those taught with traditional method.

HO_4: There is no significant difference in the attitudinal changes of male and female students taught algebra using socialist constructivist teaching strategy.

HO_5: There is no significant difference in the mean performance of male and female students in algebra exposed to socialist constructivist teaching strategy.

HO_6: There is no significant difference in the retention levels of male and female students taught algebra using socialist constructivist strategy.

1.6 Significance of the Study

If this study is effectively carried out in Kogi State, we hope the utility of constructivism would be felt by the students, teachers, government, parents and mathematical professional bodies.

Constructivist teaching strategy would elicit the mathematical realities in students and not just their performance. It would encourage our students in developing positive attitude changes towards learning and teaching algebra. Students come to learning situations with already formulated knowledge, ideas, and understandings. This acquired knowledge would serve as foundation for the new knowledge they will create. The strategy would enable the students to be reflexive on their experiences. It would also encourage students to be interactive in the classroom situation.

The constructivist teaching strategy would endow the mathematics teachers with variety of teaching methods that suit both the conceptand the students. The teacher would be endowed; with knowledge of flexibility about curriculum goals and knowledge about how students' understanding can be assessed.

The teaching strategy involves the use of variety of instructional materials like modeling, scatfolding, field trips, films and class discussion. The school administrators should try to supply needed equipped mathematics laboratory. The parents would also be made to see the need to supply wards with needed mathematics materials. Any materials not supplied by the government, Parent Teachers Association would endeavour to assist.

Mathematical Professional bodies like Mathematical Association of Nigeria, Mathematics Society of Nigeria, Science Teachers Association of Nigeria and others would encourage the mathematics teachers how to assimilate constructivism teaching strategy in the mathematics programme of our secondary schools.

On the application of the 5Es (engage, explore, explain, elaborate, and evaluate) in the teaching of algebra and mathematics in general, the students would have natural assimilation of mathematics. This would create the much desired academic achievement, retention, positive attitudes, attention and interest in learning algebra as part of mathematics.Students' interaction is well enhanced in a constructivist set up. Students are well recognized as active members of teaching-learning process. The background knowledge of students paves way for the acquisition of new algebra information. They would be able to define their questions, lay the ground work of their tasks and make corrections from known to unknown, relevance to irrelevance, concrete to abstract and so on.

Teachers acting as facilitators and coach reduce their tension in the mathematics classroom. Teacher-students interaction is well maintained in the constructivism set up.And student-student interaction is also enhanced. Mathematics teachers would cultivate interest and positive attitudes to encourage students to learn algebra. They offer activities that embrace constructivist learning styles and instructional formats to stimulate learning for all students.This leads to success of teachers in the classroom. The approach encourages the parents and guardians to provide resources and enabling environment for the children and wards to operate effectively both at school and at home. This would assist the students to be algebraic conscious in and outside the classroom.

Mathematics textbooks authors and publishers should also endeavour to write and publish mathematics textbooks that imbibe constructivist teaching strategy. The curriculum planners should also try to include constructivism teaching method during curriculum review. This would assist in the publicity and application of constructivism teaching strategy in the mathematics classroom.

1.7 Basic Assumptions:

The assumptions of the study included the followings:

(1) The schools involved in the research belong to government public schools and hence have similar background.

(2) Algebra topics for the study were covered by the selected junior secondary school three students during the administration of the research instrument.

(3) All the JSS three students had covered the JSS two Mathematics content.

1.8 Scope/Delimitation of the Study:

The study was conducted in Kogi State and used JSS three students of 2017/2018 academic session. The variables covered include socialistconstructivist teaching strategy (Independent variable). Attitude, Performance and Retention (Dependent variables). The instruments used include Algebraic Attitude Questionnaire Scale (AAQS), Algebra PerformanceTest A (APTA), Algebra Performance Test B (APTB), Algebra Retention Test (ART).Algebra aspect of the Junior Secondary School mathematics syllabus was researched on because it is used in other branches of mathematics and yet students are not performing well in it.

Due to insecurity in the state, data was collected in two out of eight educational zones.

CHAPTER TWO

REVIEW OF RELATED LITERATURE

2.1 Introduction

This study investigated the effect ofsocialist constructivist teaching strategy on attitude, performance and retention in algebra among junior secondary school students in Kogi State, Nigeria. In this chapter, a review of related literature was carried out in an attempt to put the present study in a proper perspective. The review is organized under the following subheadings:

2.2 Theoretical Framework

2.3 Conceptual Framework

2.4 Mathematics Teaching Methods

2.5 Teaching of Algebra at Secondary School Levels.

2.6 Socialist Constructivism Teaching Strategy.

2.7 Comparison between Socialist Constructivism and Traditional Method.

2.8 5Es Constructivism Learning Model and Mathematics Education.

2.9 Attitude and Performance in Algebra.

2.10 Retention of Learned Concepts in Algebra

2.11 Gender and Performance in Algebra

2.12 Overview of Similar Studies.

2.13 Implications of Literature Reviewed on the Present Study.

2.2 Theoretical Framework:

Constructivism is a theory of learning that has roots in both psychology and philosophy. The essential core of constructivism is that learners actively construct their own knowledge and meaning from their experience (Fosnot, 1996; Steffe and Gale, 1995). This core has roots that extend back through many years and many philosophers including Dewey (1938).Glasersfeld (1995) proposed three essential epistemological tenets of constructivism to which fourth have been added in light of recent writings.

(1) Knowledge is not passively accumulated, but rather, is the result of active cognizing by the individual.

(2) Cognition is an adaptive process that functions to make an individual's behaviour more viable given a particular environment.

(3) Cognition organized and makes sense of one's experience, and is not a process to render an accurate representation of reality.

(4) Knowing has roots in both biological and neurological construction, and social, cultural, and language based interactions (Dewey, 1980; Gergen, 1995).

Thus constructivism acknowledges the learner's active role in the personal creation of knowledge, the importance of experience (both individual and social) in this knowledge creation process and the realization that the knowledge created will vary in its degree of validity as an accurate representation of reality. These four fundamental tenets provide the foundation for basic principles of the teaching, learning and knowing process as described by constructivism.

Constructivism is not a unitary theoretical position; rather, it is a continuum. The assumptions that underlie this continuum vary along several dimensions and have resulted in the definition and support for multiple types of constructivism.

Typically, this continuum is divided into three broad categories: Cognitive Constructivism, Radical Constructivism and Social Constructivism.

2.2.1 Cognitive Constructivism and Mathematics Education

Cognitive constructivism represents one end or extreme of the constructivist continuum and is typically associated with information processing and its reliance on the component processes of cognition. This approach, which emphasizes the idea that the construction of knowledge is something that is done by individuals to meet their own needs, is an out growth of Piaget's model of cognitive structures as a collection of "schemes" or "Schema" Piaget, 1980). Schemas are components of an individual's general knowledge structure that relate to that individual's knowledge of the world (Rumelhart and Ortony, 1987). They are triggered by an individual's perceptions of his or her environment and provide the context on which subsequent behaviour is based.

When teachers teach mathematics courses one of the topics that our students encounter in alternative bases for numeration. A class activity for investigating this topic is Tom Bassareer Alphabitia activity (Bassareer, 2005). In this activity, the students play the role of archaeologists who "dig up" the ancient civilization of Alphabetia. From some artifacts they determine that the Alphabitians used a numeration system that consisted only the symbols A, B, C, D and O. The task for the student archaeologists is to figure out exactly how the Alphabitians were able to represent numbers with only these symbols. Of course, those readers with experience in Base 5 arithmetic will immediately see a way to do this, but our students almost always are initially baffled. We spent about a week trying different systems until we eventually converge on the Canonical Base 5 positional place value system. It is a long road for the students, but their satisfaction with their ability to construct something "brand new" is priceless.

2.2.2 Radical Constructivism and Mathematics Education:

The radical constructivist theory is associated with the work of Ernst Von Glasersfeld (1984, 1995) who built his view of constructivism on two principles. First, knowledge is not passively received; it is actively built by the individual. Second, the goal of cognition is to organize our experiences of the world by making these experiences meaningful. The adaptive nature of knowledge underscores that knowledge is not objective "truth", that is, internal knowledge does not match external reality, but rather is a viable model of experience (Von Glaserfeld, 1995). These viable models are created within an individual, influenced by the Contex within which an activity was experienced and relative to the accomplishment of a particular goal. Thus according to Staver (1995), "Knowledge is knowledge of the knower, not knowledge of the external world; improving knowledge means improving; its viability or fit in, but not match with, and external world?.

Once the initial activity of Alphabitia is completed, the students are satisfied with their ability to construct new representation for numbers. However, their knowledge is still quite limited at this point, as evidenced when the extension, to the activity is given. In the extension, we ask the students to find a way to add and subtract these new Alphabitian numerals. Once again, the students are faced with a novel situation they do not yet know how to handle. So more time is spent with the students working until they find a way to accommodate these new problems. The students once again need to accommodate a new piece of information. This time, however, their cognitive structures are working on a higher level than before. This cognitive reconstruction is called reflective abstraction, as it involves reflecting the existing cognitive structures as to a higher plane of thought and applying these structures to new stimuli.

After two weeks of work on the Alphabitian numeration system, the students have gone from an unfamiliar numeration system to adding and subtracting in this new numeration system. Of course the students have actually just computed a group structure. As such, the numeration is no longer just a set of isolated processes; rather, it has become a complete system. Once the students are able to view Alphabitia as a system, they have undergone the most radical cognitive reconstruction..

2.2.3. Social Constructivism and Mathematics Education:

By focusing on the individual learner, the cognitive and radical constructivist theories seem to either neglect or ignore the ways in which social interactions influence the process by which knowledge is constructed. Social interaction always occurs within a socio-cultural context, resulting in knowledge that is bound to a specific time and place (Gergen, 1995; Vygotsky, 1978). This position is exemplified by Bakhtin (1984), “truth is not to be found inside the head of an individual person, it is inborn between people collectively searching for truth, in the process of their dialogic interaction”. Social constructivism is more concerned with meaning than structure. It is a theory which acknowledges that both social processes and individual sense making have central and essential parts to play in the learning of mathematics and hence social constructivism is gaining in popularity. The term 'social constructivism' first appeared in mathematics from two sources. The first is social constructivist sociology of mathematics which is explicitly related to mathematics education in Restivo (1988). The second is social constructivist theory of learning mathematicsof Weinberg and Gavelek (1987). This is based on the theories of both Wittgenstein and Vygotsky. (1953 and 1978).

Ernest (1991, 1994, and 1998) introduced the term social constructivism to mathematics education.

> Social constructivism links subjective and objective knowledge in a cycle in which each contributes to the renewal of the other. In this cycle, the path followed by new mathematical knowledge is from subjective knowledge (the personal creation of an individual) via publication to objective knowledge (by inter-subjective scrutiny reformation and acceptance). Objective knowledge is internalized and reconstructed by individuals, during the learning of mathematics, to become the individuals' subjective knowledge. Using this knowledge; individuals create and publish new mathematical knowledge, thereby completing the cycle (Ernest, 1991).

Social Constructivism emphasizes the value of allowing time, instilling confidence, encouraging communication, and collective ownership of solutions developed through classroom interaction. The teaching strategy is a support for our students in developing positive attitude changes towards learning and teaching mathematics; many students attributing much of their successes in their mathematical development to the social environment in which they operat**ed.**

The former absolutist and paradigm that dominated undermined the social responsibility of mathematics in human affairs such as value, wealth and power (Ernest, 1991). Hence, social constructivism takes into account learning communities where individuals are engaged in discourse, discuss new theories, make revisions and agree upon the new resulting mathematical knowledge. Since the classroom is viewed as a "micro-world" of mathematicians that reflects the actions of the larger community of mathematicians, classroom teaching should acknowledge the belief that mathematical knowledge is socially constructed and validated (Neyland, 1995).

School algebra for most students is their first encounter with the symbol system that can use arithmetic process (Telese, 1999). In order to operate on these abstract algebraic expressions, teachers must present these expressions as mathematical objects with meaning. Both pre-service and in-service teachers must come to understand that learning algebra does have a social dimension (Telese, 1999). The reform propagating the teaching of mathematics as a social construct is a positive move, along with the introduction of mathematical literacy in many countries (Barnes &Venter, 2008).

2.3 Conceptual Framework

The Conceptual Framework adopted for this study is the learning Cycle or “5Es” illustrated in Figure 2.1.

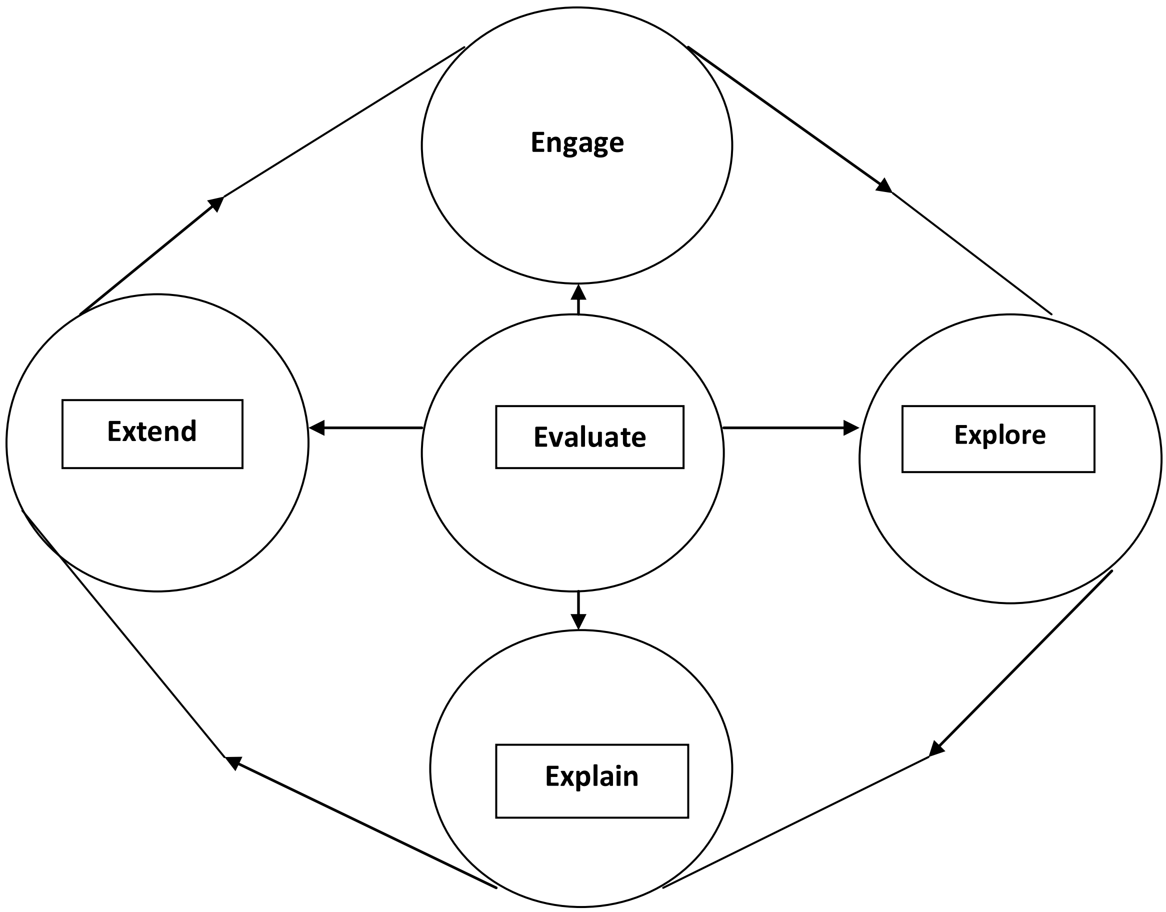

Fig. 2.1: Learning Cycle or “5es” Source:Thirteen Ed Online (2004)

Developed by the Biological Science Curriculum Study centre (BSCS), the 5E model has been used since the 1980s in many elementary, middle, and high school in the United States: Case studies of the 5E Instructional Model used against other forms of science instruction provide proof of an increased mastery of subject matter, the development of a more sophisticated scientific reasoning, and an increased interest in science.

The 5Es; is an instructional model based on the constructivist approach to learning, which says that learners build or construct new ideas on top of their old ideas. The 5Es can be used with students of all ages, including adults. Each of the 5Es describes a phase of learning, and each phase begins with the letter "E": Engage, Explore, Explain, Elaborate, and Evaluate.

The 5Es allow students and teachers to experience common activities, to use and build on prior knowledge and experience, to construct meaning and to continually assess their understanding of a concept.

Engage: This phase of the 5Es starts the process. An "engage" activity should do the following:

(1) Make connections between past and present learning experiences.

(2) Anticipate activities and focus students thinking on the learning outcomes of current activities. Students should become mentally engaged in the concept, process or skill to be learned.

Explore: This phase of the 5Es provides students with a common base of experiences. They identify and develop concepts, processes and skills. During this phase, students actively explore their environment or manipulate materials.

Explain: This phase of the 5Es helps students explain the concepts they have been exploring. They have opportunities to verbalize their conceptual understanding or to demonstrate new skills or behaviours. This phase also provides opportunities for teachers to introduce formal terms, definitions and explanations for concepts, processes, skills or behaviour.

Elaborate: This phase of the 5Es extends students' conceptual understanding and allows them to practice skills and behaviour. Through new experiences, the learners develop deeper and broader understanding of major concepts, obtain more information about areas of interest and refine their skills.

Evaluate: The phase of the 5Es encourages learners to assess their understanding and abilities and allows teachers evaluate students' understanding of key concepts and skill development.The researcher applied the 5Es in his fieldwork. The SEs was used to move form one stage to the other in the experimental lesson notes of this study.

2.4 Mathematics Teaching Methods

Every school subject has its ways of relaying information to the students. Different methods of teaching mathematics abound according to the nature of the topic, maturity and background of the students. The methods covered in this section include synthetic and analytic, inductive and deductive, dogmatic and psychological methods, lecture and Heuristic, laboratory method, cooperative learning, communication and study skills, technology-aided instruction, problem solving, direct instruction, ethno-mathematics approach, games and simulation and manipulatives, models and multiple representations approach.

2.4.1 Synthetic and Analytic Methods

Synthetic methods lead from known to unknown while analytic methods proceed from unknown to known (Schultze, 2008). In Geometry a synthetic proof starts from hypothesis and ends with the conclusion, while analysis leads from the conclusion to the hypothesis. The synthesis shows that every step is true, but does not explain why this step was taken. A synthetic proof convinces the reader that the fact to be demonstrated is true, but does not reveal to him the real plan of the demonstration, does not tell him why this sequence of arguments was selected. An analysis on the other hand, is lengthy and not elegant, but it is the only demonstration. It is a method which students can discover proofs. Analysis is the method of concise and elegant presentation. Students in secondary schools should be made to discover demonstrations by analysis, but after this has been accomplished, the proof may be represented synthetically.This method can be refined by grouping the students in the classroom lessons so that socialist constructivism teaching strategy is felt.

2.4.2 Inductive and Deductive Methods:

Inductive method leads from particular to general, from concrete to abstract, while the deductive method derives particular truths from general truths, concrete facts from abstract facts (Schultze, 2008). Inductive reasoning is not absolutely conclusive. It only establishes a certain degree of probability, which increases with the number of facts observed. Example is to find the sum of the first n natural numbers. Purely deductive methods require a formula for every type of mathematical problems and the extensive use of such methods demand memorization of many formulae. When forgetting these formulae takes place rapidly the student is utterly helpless. It is difficult for a beginner to understand an abstract piece of mathematical work if not preceded by a number of concrete instances.

For all problems of fundamental character, formulae should be memorized. For instance the formulae for the roots of a quadratic equation, the formulae for progressions, the binomial theorem etc. should be well memorized and applied. We cannot use one of these methods to the exclusion of the other. When students are grouped and guided by the teacher, socialist constructivism takes place

2.4.3 Dogmatic and Psychological Methods:

Dogmatic method makes rigor the chief consideration of mathematical study while the psychological method advocates rigor only so far as the average capacity of young students justifies it (Schultze, 2008). The dogmatists claim that the value of mathematical teaching rests mainly upon its extreme exactness, that any deviation from the absolute standard of rigor will defeat the very purpose of the entire work, and will necessarily lead to slipshod thinking. The followers of the psychological method assert that in any subject it is a mistake to consider only the scientific aspects of the subject and to ignore absolutely the degree of mental development of the student. An exactness which is not understood by the student is not exactness.

Schultze (2008) summarized the objections to extreme rigor as follows:

(1) There is no absolute rigor possible in secondary school mathematics.

(2) The rigor insisted upon in many classrooms is frequently only an exact adherence to textbook, which may and often does contain flaws.

(3) By studying exact models which he cannot understand, the student will not improve his reasoning power, for he does not do any thinking. He only repeats exactly somebody else's ideas.

(4) Student loses interest in mathematics and acquires wrong notions of mathematics in general.

(5) Students are frequently led to mechanical methods of study and the memorization.

(6) Students without mathematical ability, but with good memories, are made to consider themselves good mathematicians.

Dogmatic method is in opposition to socialist constructivist teaching strategy since it does not give consideration to learners understanding. A well guided–psychological method will fit well in socialist constructivist strategy.

2.4.4 Lecture and Heuristic Methods

Lecture method involves teachers to state demonstrations or other pieces of work without questioning the students while heuristic method attempts to make students find and discover as much as possible and to reduce direct information to a minimum (Schultze, 2008).

Schultze (2008) summarized the merits of lecture method as follows:

(1) It allows the presentation of a large amount of subject matter within a given time.

(2) It can be used for large audiences.

(3) The logical sequence of ideas is not interrupted.

(4) It is comparatively easy for the teacher.

Schultze (2008) summarized the drawbacks of lecture method as follows:

(i) Receiving information is not mathematical study.

(ii) The attention of the students is likely to wander.

(iii) The ideas follow one another so rapidly that little is comprehended during the lecture, and a great deal is left to home study.

(iv) In mathematics, the inability to understand one essential point may make the rest of the lecture unintelligible.

(v) The teacher is not in contact with his class, and is unable to determine whether or not the majority of the students are able to follow.

In general, lecturing, even to a small extent, is out of place in a secondary school, but is somewhat justified for advanced university work.

Schultze (2008) highlighted advantages of heuristic method as follows:

(1) Students think for themselves and are not merely listening for information.

(2) Students acquire a real understanding of the subject. A student who discovers solution of a problem himself has a full understanding of its difficulties and can easily reconstruct it.

(3) The interest of the students and the resulting willingness to work are greater when taught heuristically than when taught by informational methods. A student who is interested has no difficulty in paying attention, and is, as a rule, successful in his work.

(4) Teachers are in complete touch with their classes.

(5) Home study is not nearly so heavy or tedious as when informational methods are used.

Schultze (2008) highlighted the disadvantages of heuristic method as follows:

(1) The method is slow, especially in the beginning.

(2) It is sometimes difficult to make students discover certain factors.

(3) The method is difficult for the teacher for he cannot simply follow a textbook, but must constantly seek devices for leading students, devices that must be modified for different students and for different classes.

(4) The method does not work well in the hands of every teacher. Some teachers expect too much from the students and consequently accomplish hardly anything. Others expect too little, making the questions so easy that students have to answer simply "yes" or "no". The ability to ask truly heuristic questions is most essential for the mathematics teacher.

Lecture method the teacher-centered and not learner –centered and hence in opposition to socialist constructivist teaching strategy while heuristics if carried out in cooperation among the student will serve as socialist constructivist teaching strategy.

2.4.5 Laboratory Method:

Laboratory method leads students to discover mathematical facts through experiments performed by the students (Schultze, 2008). By actual weighing and measuring; areas, volumes, lines and angles are determined; and such particular mathematical relation is found as a consequence of a number of such experiments. Schultze (2008) enumerated the good features of laboratory method as follows:

(1) It is the natural way of making discoveries, the way human race has taken, is from concrete to the abstract. Laboratory work is exceedingly concrete and hence interesting and enjoyable to young students. It

emphasizes the doing; it requires the student to accomplish something that is within his capacity.

(2) The method brings the application of mathematics into prominence, while students taught otherwise are notoriously weak in applying their mathematics. Finally it gives the students a clear notion of the space concepts. A student who has measured many angles will naturally know what an angle is, a thing not all certain in the case of students whose instruction was purely theoretic.

Schultze (2008) identified the weaknesses of laboratory method as follows:

(i) It is not easy to make students discover mathematical facts by experiments.

(ii) It is an exceedingly slow method.

(iii) It degenerates sometimes into a kind of manual training.

(iv) It is based upon the wrong assumption that students cannot comprehend, and do not enjoy, demonstrational mathematics.

(v) Laboratory work and induction from experience are not typical mathematical work, and hence such methods used exclusively do not give the student any training in true mathematical thinking.

When students are given group work to carry out in laboratory method, it serves as socialist constructivist.

2.4.6 Cooperative Learning:

According to Johnson and Johnson (1989), in cooperative learning, students tend to enjoy mathematics and this enjoyment motivates them to learn.The importance of students becoming more involved in the learning process has been emphasized and needs to be implemented in classrooms around the globe (Leikin and Zaslavsky, 1992). Studies have proven effectiveness of cooperative learning on mathematics of students.

According to Johnson and Johnson (1999), Cooperative learning include five elements to enhance student learning: Positive interdependence (sense of sinking or swim together); face - to - face promotive interaction (helping each other learn, applauding successes and effort); individual and group accountability (each individual has to contribute to the group achieving its goals); interpersonal and small-group skills (communication; trust, leadership; decision-making, and conflict resolution); and group processing (reflecting on how well the team is functioning and how to function even better).

Cooperative learning involves students working together to reach a common goal (Haas, 2005). Zakaria, Chinand, David (2010) found that cooperative learning enhanced students' achievement in mathematics. Shimazoe and Al-dirch (2010) reported that cooperative learning promotes deep learning of materials and helps students to achieve better grades.Gambari. Shittu and Taiwo (2013) indicate that cooperative learning allows students to communicate their ideas with each other, brainstorm responses and work to solve problems together.

Cooperative learning is wholly socialist, constructivist teaching strategy.

2.4.7 Communication and Study Skills:

Study Skills instruction was linked with communication skills during the content-validation process. Hodo (1989) defined study skills as special abilities used when studying mathematics. For example one study skill developed by Hodo is the practice of "Studying graphs, charts, and examples to understand materials better".

Pippen and Carr (1989) indicate that there should be provision of guidance through directed reading instruction and supplemental reading guides for students as they study word problems and other difficult mathematics literature.Teachers must help students to clarify their statements, focus carefully on problem conditions and mathematical explanations, and refine their ideas (NCTM, 2000). Communication stands alone as a standard in the NCTM's Principles and Standards for School Mathematics (2000):In School, there should be a substantial growth in the student's ability to structure logical chains of thought, express themselves coherently and clearly, listen to the ideas of others, and think about their audience when they write or speak.

It involves teaching students to read and study mathematical information effectively and providing opportunities for students to communicate mathematical ideas verbally or in writing (thinking aloud) (Haas, 2005). With effective teachers guidance, communication and study skills can serve as socialist constructivist teaching strategy.

2.4.8 Technology-Aided Instruction

NCTM (2000) discussed technology as a matter of principle in mathematics instruction. Electronic technologies – Calculators and Computers – are essential tools for teaching, learning and doing mathematics. They furnish visual images of mathematical ideas, they facilitate organizing and analyzing data, and they compute efficiently and accurately. Prior to the development of the first personal computers in the early 1980s, computers were not widely used to enhance instruction. Hand-held calculators were primarily used to assist computation and for answer checking.

The method involves using computer software applications and/or hand-held calculators to enhance instruction (Haas, 2005).It is obvious that the current trend in research all over the world is the use of computer facilities and resources to enhance student's learning (Yusuf and Afolabi, (2010).

Therefore the position of mathematics makes it necessary for the use of innovative teaching strategy that will enable teachers meet the challenges of teaching and learning of the subject especially in this era of information age. Several researches have shown that using Computer Assisted Instruction (CAI) has a positive effect on students' achievement in mathematics.

The support for the use of computers in teaching and learning is widespread. Some educationalist say that the most powerful use of computing technology is as a tool for cognitive amplification or to enable students to explore mathematical concepts and through this exploration construct mathematical understandings.Norton, Cooper, and Mc Robbie(2010). Others note that the increasing power of computers enables them to exhibit artificial intelligence that can be used as surrogate tutors of mathematics. The most recent of such programmes are Integrated Learning Systems (ILS) that present lessons, assess student responses and provide remedial feedback as well as monitor student progress (Norton, Cooper and Mc Robbie 2010).The potential benefits of Computer Assisted Instruction (CAI) cannot be underestimated in the contemporary world

(Gambari, Shittu and Taiwo; (2013). There are now several CAI Packages on different subjects.

Technology – aided instruction exposes students to meaningful and practical learning and hence it is an aspect of socialist constructivist teaching strategy.

2.4.9. Problem Solving Strategy:

Polya (1945) developed the following four principles for a successful problem solving technique:

First Principle:Understand the problem.

Polya taught teachers to ask students questions such as:

- Do you understand all the words used in stating the problem?
- What are you asked to find or show?
- Can you restate the problem in your own words?
- Can you think of a picture or diagram that might help you understand the problem?
- Is there enough information to enable you find a solution?

Second Principle:Devise a plan.

Polya mentions that there are many reasonable ways to solve problems. The skill at choosing an appropriate strategy is best learned by solving many problems. A partial list of strategies is included: Guess and check, make an orderly list, eliminate possibilities, use symmetry, consider special cases, use direct reasoning, solve an equation, look for a pattern, draw a picture, solve a simpler problem, use a model, work backwards, use a formula and be ingenious.

Third Principles:Carry out the plan.

This step is usually easier than devising the plan. In general, all you need is care and patience, given that you have the necessary skills. Persist with the plan that you have chosen. If it continues not to wok discard it and choose another. Don't be misled; this is how mathematics is done, even by professionals.

Fourth Principle: Look back.

Polya mentions that much can be gained by taking the time to reflect and look back at what you have done, what worked, and what didn't. Doing this, will enable you to predict what strategy to use to solve future problems.

In the NCTM's latest standards document (2000), Problem-based learning is strongly endorsed:Successful problem solving requires knowledge of mathematical content, knowledge of problem-solving strategies, effective self-monitoring, and a productive disposition to pose and solve problems. Teaching problem solving requires even more of teachers, since they must be able to foster such knowledge and attitudes in their students.

Human beings face various problems in life and they try to solve them. It is important for students to be prepared to face real problems in their learning environment and produce appropriate solutions.

It is a framework for instruction used in every area of mathematics. Marzano, Pickerig and Pollock (2001) regarded problem solving as generating and testing hypothesis where students apply knowledge to new situations by induction or deduction. The method involves appropriate questioning strategies used to guide a student to discover the solution of a problem.

Teaching through problem solving where students apply a general rule (deduction) or draw new conclusions or rules (induction) based on information presented in the problem. (Hass, (2005). The skills of problem-solving,critical thinking and learning are developed (Ajai, Imoko and Okwu, 2013).

Problems-solving strategy engages the learner from beginning to end of the lesson and hence it is a socialist constructivist teaching strategy.

2.4.10 Direct Instruction

Establishing a direction and rationale for learning by relating new concepts to previous learning, leading students through a specified sequence of instructions based on predetermined steps that introduce and reinforce a concept and providing students with practice and feedback relative to how well they are doing (Haas, 2005). It is a teaching method that may encompass all of the others. It is a framework for instruction in every area of mathematics. Grading homework to provide feedback was most strongly associated with the definition for direct instruction.

When observing a teacher, the administrator should look for instances where the teacher collects homework to provide written feedback to students, rather than simply checking for effort. Specific comments help students to identify error patterns and correct or incorrect thinking. If a teacher indicates that there are too many exercises to "grade" on a typical homework assignment, this may also indicate that there are too many exercises assigned. Practice is important, but practice with feedback is even more beneficial.

Direct instruction enables the learner to be an active participant in a classroom lesson and hence it is a socialist constructivist teaching strategy.

2.4.11 Ethno-Mathematics Approach:

The term ethno-mathematics was introduced by the Brazilian educator and mathematician Ubiratan D' Ambrosio in 1977. According to him, ethno refers to the cultural context while 'mathema' refers to explain, to know or to understand and 'tics' has to do with techne which is also rooted in art, skill or technique. He thus defined ethno-mathematics as mathematics which is practised among identifiable cultural groups such as national, tribal, societies, labour groups, children of certain age brackets, professional classes and religious tradition (D' Ambrosio, (1985). Identifiable cultural groups according to Carss (1986), include groups of people (ethnic groups) who share common and distinctive characteristics such as ideologies, behaviour, hopes, fears, language and culture.

The ethno-mathematics approach to teaching of mathematics according to D'Ambrosis (2001) is an approach or technique of teaching and learning mathematics which builds on the students' previous knowledge, background, the role his environment plays in terms of content, methods and his past and present experiences of his immediate environment. The focus of ethno-mathematics is to determine how familiar situations and visual approaches integrated with systematic Eurocentric activities can be used to help learner's different cognitive skills to improve their level of mathematical functioning as well as performances in a wider range of mathematical objectives (Kurumeh, 2007). The approach entails situating learning and problem solving in real life context where the environment is very rich in information with physical materials that serve as a source of manipulative and interactive processes (Kurumeh, Onah and Mohammed 2012). Students are made to link the past to the present so as to build the future.

Ethno-Mathematics Approach encourages the learner to effectively utilize his environment mathematically. Hence it is an aspect of socialist constructivist teaching strategy.

2.4.12 Games and Simulations:

Mathematical games also called educational games have been defined as an enjoyable social activity with goals, rules, and educational objectives (Stephen and Cary, 1994). Mathematical game approach involved two or more students working together to find a solution to a given mathematics problem. In a mathematical game, the winner, the loser and the spectator(s) are all expected to learn the mathematics concept being practised in the game. Educators and researchers have recommended the use of educational games in teaching and learning of mathematics because it is found to sustain and develop students' interest and achievement in mathematics.

Agwagah, (2001) researched on number base using board in junior secondary two. As contribution and availability of games for use in schools, Ukeje and Obioma, (2002) compiled 53 mathematical games for teaching in both Primary and Secondary Schools. Obodo, (2004) treated 20 educational games in his book "Principles and Practice on Mathematics Education in Nigeria" and developed many mathematical games for teaching mathematics in the primary schools

Bala and Musa (2006) researched on number base game in senior secondary school and found that the number base game was effective in the students' mathematics achievements. Clement,Benjamin and David. (2013) investigated into the teaching and learning of algebraic linear equations in junior secondary three using algebraic substitution game to arouse their mathematics thinking which enhanced their achievement in mathematics.

Games and simulations encourage the learner to be an active participant in a mathematics class. It is therefore a part of socialist constructivist teaching strategy.

2.4.13 Manipulatives, Models and Multiple Representations Approach

The NCTM (2000) included manipulatives, models and multiple representations approach within its representation standard, stating that instructional programme should enable students to create and use representations to organize, record and communicate mathematical ideas; select, apply and translate among mathematical representations to solve problems; and use representations to model and interpret physical, social, and mathematical phenomena.

The teaching method to apply depends on the teacher's ability to teach in a way in which learning is viewed by students as meaningful and significant. The teacher's ability to adjust teaching strategies as warranted by changes in the teaching and learning situation.Teaching students techniques for generating or manipulating representations of mathematics content or processes, whether concrete, symbolic, or abstract (Haas, 2005). The method includes a variety of activities such as creating graphical representations, making physical models, generating mental pictures, drawing pictures and pictographs, and engaging in kinesthetic activities.

A well-guided and controlled manipulatives, models and multiple representations approach plays the role of socialist constructivist teaching strategy.

2.5 Teaching of Algebra at Secondary School

Algebra is a branch of mathematics that uses mathematical statements to describe relationships between things that vary over time. These variables include things like the relationship between supply of an object and its price. When we use a mathematical statement to describe a relationship, we often use letters to represent the quantity that varies, since it is not a fixed amount. These letters and symbols are referred to as variables (http/cst/sry.edu/fipse/Algebra/unit/algebra.htn) Retrieved on 17thAugust 2015. Algebra is a branch of mathematics in which symbols (usually letters) represent unknown numbers in mathematical equations (Microsoft Encarta, 2009).

Algebra is often the first mathematics subject that requires extensive abstract thinking, a challenging new skill for many students (U.S. Department of Education, 2015). Algebra moves students beyond an emphasis on arithmetic operations to focus on the use of symbols to represent numbers and express mathematical relationships. Understanding algebra is a key for success in further mathematics courses, including geometry and calculus. Many mathematics experts also consider algebra knowledge and skills important for post-secondary success as well a for producing a skilled workforce for scientific and technical careers. Algebra requires proficiency with multiple representations, including symbols, equations, and graphs as well as the ability to reason logically, both of which play crucial roles in advanced mathematics courses.

General methods for teaching mathematics are also applicable to the teaching of algebra. But sometimes researchers go further to develop specific strategies for teaching algebra. In one of such moves is that of Linsell, Tozer and Anakin (2012) that worked on “Teaching algebra conceptually in Years 9 and 10”. Teaching approaches in the study were not uniform, but were responsive to the particular needs of each class of students and also reflected the teaching styles and beliefs of the teachers involved.

There was, however, a great deal in common and a consensus was achieved on effective ways to help students learn algebra. Effective teaching approaches involved:establishing what each student understands through assessment; showing students how algebra is everywhere in our lives; promoting algebraic thinking with rich and meaningful contexts; demonstrating the benefits of rigour and correct use of vocabulary and building a “toolbox” of knowledge and skills that students can use appropriately and efficiently.

2.5.1 Assessment in Algebra

It is essential to know where the students are so that we could make decisions about next learning steps, especially as students came from a number of contributing schools and therefore had widely differing prior experiences. A great deal of time must be spent over appropriate diagnostic assessment information. The purpose is to document the most sophisticated strategies that a student could use and to identify their prerequisite knowledge, not to generate score.

Warren (2003), the diagnostic assessment revealed that many students did not have a good understanding of arithmetic structure, inverse operations or equivalence. Students' knowledge of algebraic notation and conventions and acceptance of lack of closure were also documented, as well as their strategies for solving equations, expressing generality and finding relationships between variables. Teachers' approaches with their classes and interventions with individual students are guided by the detailed knowledge they had acquired.

2.5.2 Algebra Everywhere:

The teaching approaches rejected the common practice of teaching algebra as isolated units of work once a term, or, even worse, once in a year. Instead, the teachers should integrate the teaching of algebraic thinking throughout their programmes. For example, when teaching equivalent fractions such as:

3/4 = 9/12 and 55/25 = 11/5 by multiplying or dividing numerators and

denominators by the same factor, this can be generalized to $\frac{ac}{ab} = \frac{c}{b}$

The generalization, and the use of algebraic notation to describe the generalization is made explicit to the students. Teachers placed a great deal of emphasis on the patterns found when calculating with rational numbers and with rational expressions, including during topics such as geometry. The algebraic skills taught should be used throughout the year in a variety of contexts and reinforced through regular maintenance.

2.5.3 Rigour and Vocabulary

It was observed that very informal written working and a lack of correct mathematical vocabulary are impediments to good mathematical practice and engagement in mathematical discourse. Teachers should be very careful with correct usage of mathematical vocabulary throughout the year. Any terms that are unfamiliar or ambiguous to the students should be defined and written into the students' notebooks. Teachers should be very careful so that their board work model the correct setting out, and they insist on their students meeting similar standards. They should not assume their students know the conventions of notation, but explicitly teach the conventions. Mathematical identities and laws should be made explicit and expressed as generalizations using algebraic notation. The schools should ensure that there is consistency from teacher to teacher and from one year level to the next.

2.5.4 Algebra Toolbox

When algebraic skills are identified, they are presented to the students as tools to put in their toolboxes. The metaphor is used to promote acceptance and understanding of the skills. These skills included, but not limited to, substitution, manipulating skills, expanding brackets, factorizing and strategies for solving equations. Number skills related to indices, integers, order of operations, basic facts, squares, cubes, and highest common factors were placed in the students' toolboxes. When solving problems in any context, students are encouraged to select and use tools purposefully. This approach avoid skills being taught in isolation, as students appreciate that these are tools that they would use frequently. Thus the skills become more readily transferrable.

2.5.5 Algebra Context:

It is essential that students should perceive algebra as being meaningful, and a wide variety of contexts were used to ensure this. When solving problems in areas such as rational number, students are encouraged to use modeling approaches and set up equations to solve. Science teachers are consulted to ensure that approaches to solving equations and using notation are consistent between mathematics and science lessons. All the indicated steps a teaching Algebra are in line with socialistic constructed teaching strategy.

2.6 Socialist Constructivism Teaching Strategy:

It is now well accepted that, according to the Socialist constructivist view of learning mathematics, students construct their own mathematical knowledge rather than receiving it in finished form from the teacher or a textbook. Within this framework, this means students create their own internal representations of their interactions with the world and build their own networks of representations (Hiebert and Carpenter, 1992).Constructivist pedagogy, the link between theory and practice, suffers from the breath of its theoretical underpinnings. Many theorists and practitioners (Jonassen, 1991; Brooks &Brooks, 1993; Driscoll, 1994) have generated constructivist pedagogies with an array of results. While these pedagogies share a set of core design principles, the peripheral principles tend to vary greatly. The general theoretical and practical constructivist consensus, however, across all three types of constructivism, indicate that eight factors are essential in constructivist pedagogy (Brooks &Brooks, 1993) Larochelle, Bednarz, and Garrison, 1998; Steffe and Gale, 1995). It should be noted, though, before the discussion of these principles begins, that these principles are not solely constructivist in nature indeed, all of these principles have been proposed by other theories/theorists in other times. What makes this list "constructivist" is the assemblage of these specific principles and the basis/rationale for their inclusion.

(1) Learning should take place in authentic and real-world environments**.**

Whether building accurate representations of reality, consensual meanings in Social activities, or personally coherent models of reality, experience is paramount.

Experience, both socially oriented and object oriented, is a primary catalyst of knowledge construction. Experience provided the activity upon which the mind operates. In addition, knowledge construction is enhanced when the experience is authentic. For the cognitive constructivist, authentic experiences are essential so that the individual can construct an accurate, representation of the "real"world; not a contrived world. For the social and radical constructivists, authentic experiences are important so that the individual may construct mental structures that are viable in meaningful situations.

(2) Learning should involve social negotiation and mediation. While only social constructivism emphasizes social interaction is a basis for knowledge construction, cognitive and radical constructivists' do assign social interaction, a role. Social interaction provides for the development of socially relevant skills and knowledge, as well as providing a mechanism for perturbations that they require individual adaptation. In some cases, such as cultural mores and culturally arbitrary rituals (e.g. greetings, gender relations, dress), knowledge can only be attained through social contact. In addition, as an individual gains experience in a

social situation, this experience may verify an individual's knowledge structures or it may contradict those structures. If there is contradiction or confusion, then the individual must accommodate this contradiction in order to maintain either an or social model of reality. Finally, an integral component of accurate model of reality or a coherent personal or social mediation is the use of language. Language is the medium through which knowledge and understanding are constructed in Social situations (Spivey, 1997).

(3) Content and skills should be made relevant to the learner. All three types of constructivism emphasize the concept that knowledge serves an adaptive function. If knowledge is to chance one's adaptation and functioning, then the knowledge attained (i.e. content and skills) must be relevant to the individual's current situation understanding and goal. This relevancy is likely to lead to an increase in motivation (Pintrich and Schunk, 1996), as the individual comes to understand the need for certain knowledge. Ultimately, experience with relevant tasks will provide the individual with the mental processes, social information and personal experiences necessary for enhanced functioning within one's practical environment.

(4) Content and skills should be understood within the framework of the learner's prior knowledge. All learning begins with an individual's prior knowledge, regardless of constructivist affiliation. Understanding a student's behavior requires an understanding of the student's replies that the answer to 54 - 38 is 24, the teacher must not think "Oh, that is wrong" but rather "What is the student's understanding of subtraction that has led to this answer?. In this case, the

student appears to be using the followingrule of subtraction, subtract the smallest from the largest". While this rule is "in correct" given our current system of mathematics, it is, none the – less, the rule, the student is using. Understanding the student's rule usage makes it much easier for the teacher to demonstrate, using manipulatives of some type, the non-viability of the student's understanding (i.e. have the student count out 54 blocks, then take away 38 blocks, form that pile, and finally count the remaining (16). Only by attempting to understand a student's prior knowledge will the teacher be able to create effective experiences, resulting in maximal learning.

(5) Students should be assessed formatively, serving to form future learning. Cognitive, radical and social constructivism all assert the acquisition of knowledge and understanding is an ongoing process that is heavily influenced by a student's priorknowledge. Unfortunately knowledge and understanding are not directly visible, but rather must be inferred from action. Thus, to take into account an individual's current level of understanding in this ongoing teaching and learning process, a teacher must continually assess the individual's knowledge. A concept of the psychological tools and Piaget's (1980) concept of reflective abstraction respectively, Vygotsky (1978). This formative assessment is necessary to accurately create the next series of experiences and activities for students.

(6) Students should be encouraged to become self-regulatory, self-mediated, and self-aware. The underlying tenet of constructivism, and the main thread that holds together this array of theoretical positions, is the claim that learners are active in their construction of knowledge and meaning. This activity involves mental

manipulation and self-organization of experience and requires that students regulate their own cognitive function, mediate new meanings from existing knowledge, and form an awareness of current knowledge structures. While cognitive constructivism would emphasize self regulation and self awareness; radical and social constructivism would emphasize self-mediation.

Self-mediation is represented within radical and social construction by concept of the psychological tools and Piaget's (1980). Vygotsky, (1978) believed that students construct mental signs or psychological tools, to represent concepts and relationships, and that these tools are used to mediate "inter-mental" cognition. Similarly, Piaget (1980) theorized that students mentally reflect on the use and nature of objects and then construct new knowledge by generalizing, or abstracting new relationships.

(7) Teachers serve primarily as guides and facilitators of learning, not instructors.In the cognitive constructivism; the role of the teacher is to create experience in which the students will participate that will lead the appropriate processing and knowledge acquisition. Consequently, cognitive constructivism supports the teacher as a guide or facilitator tothe extentthattheteacherisguidingorfacilitatingrelevant processing. In radical and social constructivism, the only role for the teacher is to guide students to an awareness of their experiences and socially agreed upon meanings. This teacher as guide metaphor indicates that the teacher is to motivate, provide examples, discuss, facilitate, support, and challenge, but not to attempt to act as a knowledge conduit.

(8) Teachers should provide for and encourage multiple perspectives and representations of contact. The relationship of multiple perspectives and multiple representations is one of cause and effect within cognitive constructivism. Experiencing multiple perspectives of a particular event provides the student with the raw materials necessary to develop multiple representations. These multiple representations provide students with various routes from which to retrieve knowledge and the ability to develop more complex schemas relevant to the experience.

In addition, in radical and social constructivism, there is no privileged "truth", only perceptual understanding that may prove to be more or less viable.
This being the case, a student's understanding and adaptability is increased when he or she is able to examine an experience from multiple perspectives. These perspectives provide the student with a greater opportunity to develop a more viable model of their experiences and social interactions.

2.7 Comparison betweenSocialist Constructivism and Traditional Methods:

Performance in Mathematics is a function of the applied teaching strategy rather than any other variable. The following table summaries the comparison between constructivism and traditional methods.

Table 2.1 Comparison betweenSocialist Constructivism and Traditional Methods:

Traditional Classroom	Socialist Constructivist Classroom
Begins with parts of the whole-emphasizes basic skills	Begins with the whole expanding to parts
Strict adherence to fixed curriculum	Pursuit of student questions/interest
Textbooks and workbooks.	Primary Sources manipulative materials
Instructor gives students/students receive.	Learning is interaction building on what students already know.
Instructor assumes directive authoritative role.	Instructor interacts/negotiates with students.
Assessment via testing/correct answers.	Assessment via student works, observations points of view, tests, Process is as important as product.
Knowledge is inert	Knowledge is dynamic/changes with experiences.
Students work individually.	Students work in groups.

SOURCE: Thirteen Ed. Online (2004)

2.8: 5Es Constructivism Learning Model and Mathematics Education

The Five E (5E) instructional model is a research-based lesson cycle that has been shown to increase student achievement. The 5E mode was originally developed as a framework for developing inquiry-based lessons for science educators. However, because mathematics educators are embracing an inquiry approach to mathematics instruction, the 5E model can be used to implement high-quality, effective instruction for mathematics as well.

The 5E Instructional model is a constructivist model with 5 stages: Engage, Explore, Explain, Elaborate, and Evaluate. The first stage of the model starts by accessing the students' prior knowledge. Then, connections are established between this prior knowledge and new knowledge which is acquired by means of investigation and discoveries. The 5E model provides direct instruction of ideas that students would be able to discover on their own, as well as opportunities to demonstrate understanding through practical application.

By implementing the constructivist approach of the 5E lesson model in an innovative and creative way, students were immersed in mathematical content and participated at a higher cognitive level, while having fun. Ross (2006) investigated on "The effects of Constructivist teaching approaches on middle school students' Algebraic understanding" and the findings revealed the positive effects of such approaches on students' procedural knowledge and conceptual understanding. Major and Mangope (2012) worked on the Constructivist Theory in Mathematics: The case of Botswana Primary schools and concluded the knowledge is not passively received, but actively built up by the learners. Constructivism, therefore, encourages learners to be given the opportunity to construct their own knowledge from the previous experience so as to be able to apply theory to practice and to make meaningful connections to what they learn to the real world.

The present study has advantage of inclusion of 5Es in the applied treatment.Skamp and Peers (2012) investigated on implementation of Science based on the 5E learning model: Insight from teacher feedback on trial primary connections units concluded that primary connections has had a very real and positive influence on most (if not all) responding teachers' thinking about the nature of inquiry – oriented and constructivist-based (as in the 5E model) science learning at the primary level. This overall impression is significant as for teachers to change their pedagogical practice towards innovative Science practices such as inquiry-oriented science and use of the 5E learning cycle. The study is similar to the current one, but it was carried out on primary school while the present study was carried out in Junior Secondary school.

Robertson, Meyer and Wilkerson (2012) on the study "The Mathematics of Skate boarding: A Relevant Application of the 5Es of constructivism" observed that the students' actions showed their enjoyment of learning mathematics through Skateboarding as a result of making personal and relevant connections to their own experience and interests. The students learned a lot of set-confidence in their skills through being able to work in a small teacher to student ratio situation and also in being able to work with their peers to solve problems. The students learned a lot about problem solving and using multiple skills to solve mathematical problems. Often classroom face the pressures of high stakes testing and of covering massive amounts of material in limited periods of time. In mathematics, students are often not engaged and do not seem to enjoy learning skills, nor do they see connections between the real world and the topics being studied. The study is similar to the carried out one except.

Gambari, Shittu and Taiwo (2013) investigated on Enhancing Students' Understanding of Algebra Concepts through Cooperative Computer Instruction and found out that the use of computer assisted instruction in either cooperative or individualized settings seems to be the answer. Cooperative Computer Instruction and Individualized Computer Instruction were more effective in teaching the Mathematical Concepts of Algebra. This study is socialistic constructive of except the absence of 5Es.

Ilyas, Rawat, Bhatti and Malik (2013) researched on Effect of Teaching Algebra through social constructivist approach on 7^{th} Graders' Learning Outcomes in Sindh (Pakistan) and concluded that social constructivist approach worked better than our existing one-way teaching. It not only yielded better learning outcomes but also provided opportunities for students to interact with others, to share one's ideas and listen to others (peer or teachers) point of view, to develop social interaction and communication skills, and to learn collaboratively in a free and friendly environment. The difference between this study and the present study is non-inclusion of 5Es.

Tuna and Kacar (2013) researched on the affect of 5E learning model in teaching Trigonometry on students' academic achievement and the permanence of their knowledge found that 5E learning cycle model influence not only the students' achievement but also the permanence of knowledge. The study is similar to the present study, but they worked on trigonotrim and algebra respectively.

Kajuru and Kauru (2014) worked on the Effects of the 7E's Constructivist approach to Teaching Trigonometry on Polytechnic students' achievement and retention in Kaduna State and found out that 7E's Constructivist Approach has enhanced the performance, achievements and retention ability and attitude of students towards trigonometry. The difference between this study and the current study is on the category of students used for the research. This study used students tertiary institution while the present study uses junior secondary school students.

2.9 Attitude and Performance in Algebra:

Olaosebika (2005) in his study on attitude of students towards Mathematics stated that attitude is related to the achievement and enrolment in the subject. According to him, poor attitudes lead to poor achievement and poor achievement leads to not offering the subject.Bora (2012) worked on "Evaluation of School students' attitude towards learning Mathematics and found that attitude level is not satisfactory. He went further to say that attitude level is highly affected by gender of the students and environment of the schools. Unlike this study the present study is not locational concic us.

Mahanta and Islam (2013) investigated on the attitude of secondary students towards mathematics and its relationship to achievement in Mathematics concluded that attitude of students and achievements are positively correlated.Mahanta and Islam (2013) defines attitude as a learned predisposition or tendency on the part of the individual to respond positively or negatively to some object, situation, concept or another person. A person's attitude determines how he will be in a future situation, independent of the circumstances that present themselves.

2.10 Retention of Learned Concepts in Algebra:

Hornby (2000) defines retention as the ability to remember or recognize what has been learned or experienced.

Kurumeh, Onah, Mohammed (2012) investigated on "Improving Students" Retention in JSS statistics using Ethno-Mathematics teaching approach in Obi and Oju Local Government Areas of Benue State and observed that the use of Ethno-mathematics approach has proved to produce higher retention rate for JSS III students in statistics than their counterpart taught with conventional method. The study is on aspect of socialist, constructivist approach with non-application of 5Es.

Kajuru and Kauru (2014) defined retention as the ability to retain and later recall information or knowledge gained after learning. They researched on the effects of the 7E's constructivist approach to teaching Trigonometry on Polytechnic students' achievement and retention in Kaduna State and found that the approach enhanced the performances, achievements and retention ability of students in trigonometry. This study is related to the current study except that this study dealt with trigonometry while the current study dealt with algebra.

2.11 Gender and Performance in Algebra

Numerous studies in Mathematics with reference to gender have been carried out. There is no definite pattern in the obtained findings. Sometimes male performs better than females, sometimes female performs better than male and other times there is no significant difference in the performance of the male and the female.

Yusha'u (2013) researched on "Investigating and Remediating Gender Difference in Mathematics Performance among Dyslexic and Dyscalculic learners in Sokoto State" and found out that there was no significant gender difference between control and experimental groups before remediation. He also observed that there was no significant gender difference in the level of academic performance after remediation. This study did not apply socialist constructivist strategy.

Anyor and Iji (2014) investigated on the "Effect of Integrated Curriculum Delivery Strategy on Secondary School students' Achievement and Retention in Algebra in Benue State" reveals that there is no significant difference in the mean achievement scores of male and female SSIstudents taught Algebra in the experimental group. Also theydiscovered that there is no significant difference in the mean retention scores of male and female SSI students taught Algebra in the experimental group. Kauru (2014) researched on "Impacts of Constructivist teaching strategy on students' academic achievement, retention and attitude towards Trigonometry in Senior Secondary Schools in Kaduna State" and observed that there was significant difference in the mean academic achievement scores of male and female students exposed to constructivist teaching strategy and those taught using lecture method. He also observed that there was significant difference in the mean retention scores of male and female students exposed to constructivist teaching strategy and those taught using lecture method. He went further to reveal that there was no significant difference in the mean attitude scores of male and female students taught using constructivist teaching strategy and those taught using lecture method. This study worked on trigonometry while the current study dealt with algebra.

Salman and Ameen (2014) worked on "Comparative effects of two problem-solving models on Senior Secondary School students' performance in Mathematics word problems" and found out that gender had no influence on the performance of students taught using the instructional model of Brandsford and Stein. This study is socialistic constructivist, but no application of 5Es.

2.12 Overview of Similar Studies

This section reviewed some relevant literature to socialist constructivism and algebragenerations of outstanding mathematicians who were engaged in mathematical problems, who communicated with their colleagues about their work, required thousands of years to develop mathematics that we expect our average elementary school students to construct (Richards, 1991).

Wood (1995) asserted that teachers must construct a form of practice that fits with their student's ways of learning mathematics. This is the fundamental challenge that faces mathematics teacher educators. We are to reconstruct what it means to know and do mathematics in school and thus what it means to teach mathematics.

The challenge is how can mathematics teachers foster students' construction of powerful mathematical ideas that took the community of mathematicians, thousands of years to develop? Richards asserts: It is necessary for the mathematics teacher to provide a structure and a set of plans to support the development of informed exploration and reflective inquiry without taking initiative or control away from the student. The teacher must design tasks and projects that stimulate students to ask questions pose problems, and set goals. Students will not become active learners by accident, but by design, through the use of the plans that we structure to guide exploration and inquiry.

Social Constructivism as a philosophy of mathematics has the potential for providing a foundation for the teaching of algebra. Since mathematics is a language and especially school algebra as a symbol system it follows that an approach to teaching school algebra should include a historical background of concepts, discourse for establishing for symbols and the use of mathematical language for describing social phenomena and in verifying proofs developed within the micro-community of the classroom, algebra, as a language, has its semantic and syntactic meanings. School algebra teachers should be adept at developing both meanings during instruction. School algebra students' informal knowledge should be used to develop a formal knowledge of the semantics and syntax of algebra. They should develop the capabilities for providing historical backgrounds of particular concepts so that their students can gain a sense that mathematics is a human creation and abstract algebra and proofs should have a larger role the teaching of school algebra.

Perry, Geoghegan, Owens and Howe (2000) carried out investigation on cooperation and social constructivism in Mathematics education. The primary aim of the study was to measure students' levels of Mathematical achievement after a semester in an elective subject called mathematics for K-6 Teachers. The approach used paired groups to encourage discussion as students sought to solve mathematical problems. After exploring problems in pairs, whole-class student-led sharing sessions allowed students to further extend their collaborative efforts to construct meaning by clarifying solutions. The content of the classes came mainly from the High School Certificate syllabus Mathematics in society and the problems used were similar to those in past examination papers. The learning cycle used incorporated experiencing, discussing, generalizing and applying new learning. Each student was expected to record in a journal, their reactions to the course, attempts at solutions to the activities and any other feelings they might have had. There were also attitudinal entry and exit results for the 37 students who participated. Considerable data indicated that cooperative learning was a clearly expressed support for our students in developing positive attitude changes towards learning and teaching Mathematics. Many students attributing much of their success in their mathematical development to the cooperative environment in which they operated. It is overly simplistic and not useful to connect constructivism to teaching with the romantic notion, "Leave students alone and they will construct mathematical understandings" Likewise, "Put students in groups and let them communicate as they solve problems", is much more helpful (Simon, 2005).

Ross (2006) investigated on "Effects of Constructivist teaching approaches on Middle School students' algebraic understanding". The model involved constructivist approaches with six indicators of enactive representations, encouraging student independent thinking, creating problem-centred lessons, facilitation of shared meanings student justification of ideas, and receiving feedback from the teacher. Three of the teachers used mostly constructivist approaches while the other four utilized a more direction instruction format. The choice in teaching approach promoted vast differences in the behaviours of both teacher and students. In constructivist approaches, teachers played the role of facilitator in lessons, whereby students were guided during their inquiry of mathematical ideas. During these lessons, students were actively working on solutions and engaging in discussions with peers. On the contrary, the teachers who used more direct instruction approaches on lecture as the main foray of knowledge dissemination students quietly sat at their desks filling out worksheets. The tasks required very little reasoning skills on the part of the students. Instead, they busily worked on ideas that had already been explicitly lectured to them. This study was conducted examining middle school students and their understanding of the entire algebra strand. This study is related to the current one except non-application of 5Es.

Major and Mangope (2012) carried out a study on “The Constructivist Theory in Mathematics: the Case of Botswana Primary School”. The researchers used data from Human Research Science Council (HRSC) – Stanford – University of Botswana Regional Education Study that was conducted in 2009/10 as a comparative study on teacher quality and student performance in Botswana and South Africa. Out of 60 sampled schools in Botswana, data was collected in 58 schools and 64 classrooms (two mathematics classrooms in six of the schools taught by the same teacher in each school). Data was collected through videotaping, 83 mathematics lessons. More than one-third of the teachers were videotaped twice. The filming was done at the middle and towards the end of the year by trained personnel of the Botswana team from the University of Botswana.

Teachers whose classes were videotaped were informed in advance about the research team visits. They were further told that the videos would be used for the study. The videotape analysis was also done by well trained personnel from the University of Botswana and the United States of America. Bar charts were used for the analysis. The findings indicated that 73.5% of the lessons required to recall a fact which is memorization, 85% of the lessons do procedures without connections, 23% do procedures with connections and only 3% students explore and investigate the nature of the concepts and relationships. From the video note observations the data indicates that in most lessons teachers asked the students questions and allowed the whole class to call out the answers. The continued teacher domination in the Botswana teaching and learning environment will resultin learners who cannot think deeply and critically. Knowledge is not passively received, but actively built up by the learners. Constructivism, therefore, encourages learners to be given the opportunity to construct their own knowledge from the previous experiences to be able to apply theory to practice and to make meaningful connections to what they learn to the real world. This study is socialist constructivist with no application of 5Es.

Skamp and Peers (2012) carried out investigation on “Implementation of science based on the 5E learning model: Insights from teacher feedback on trial Primary Connections Units” and the following observations were made. The overall approach used in this project was mainly a qualitative content analysis of the comments that teachers made in their feedback about trialling of Primary Connections Units. The sample was predetermined by the availability of written teacher feedback about the implementation of trial Primary Connections Units. This feedback was provided to the Primary Connections team over a period of six years (2005-2012). A selection of teacher feedback from sixteen units was selected. Four units were selected from each of the four conceptual strands of ‘life and living’, ‘Energy and change’, ‘Natural and processed materials’ and ‘Earth and beyond’. Further input from selected teachers was obtained from a two-tier multiple choice test that determined teachers’ understanding of the purposes of the Explore, Explain and Elaborate phases of the 5E learning cycle. Approximately 60 tests were distributed by e-mail and 11 returned, {response rate about 18 percent). There was a strong inquiry orientation during the implementation of the Primary Connections Units. All students often collected data (first hand and from secondary sources) about the world around and were learning actively (physically and usually mentally). When students recorded electronically this seemed to heighten motivation. Students regularly used science inquiry skills especially observation. prediction, recording and fair testing. This study was 5Es socialist constructivist it was based on constructivist, but it was based on science in general while the current study is on algebra.

Robertson, Meyer and Wilkerson (2012) researched on “The mathematics of Skate boarding: A relevant application of the 5Es of Constructivism”. It is a position paper and the following observations were made: Establishing a relevant and relatable connection to content is critical to gaining student interest and increasing motivation in classroom topics, especially in the areas of mathematics and science. For high school students, a critical point comes at the beginning of a lesson, as they quickly decide if they will actively participate or withdraw from instruction. Engagement activities should help the students to make connections between past and present learning experiences, to move the students to become thoughtfully involved in the concept, process or skill to be learned. In a constructivist framework, the exploration phase should provide students with a common base of experiences and build on the aspects of the engagement activity directly. Since mathematics is often called "the language of Science" and has relevant and practical connection to both Algebra and Geometry, the context for this integration of physics concepts and mathematical processes seemed quite appropriate. The purpose of this interdisciplinary approach within the exploration phase was to allow the students to explore meaningful science and mathematics topics set in the context of something they enjoy doing. As students explored mathematics and science concepts in a real context, they developed a broader understanding of those principles. When students are able to share their experiences through small group discussions, they are able to strengthen their understandings of the mathematical concepts. This sharing within cooperative groups approach is a fundamental strategy in the constructive approach as it allows the teacher to facilitate the learning process, and also helps students to develop a common base of experiences on which to make connections to content. The elaboration phase was designed to extend student's conceptual understanding into applications of skills and behaviours, and to deepen and broaden their content knowledge. The evaluation phase required learners to assess their own understanding and abilities as well as allowed the teacher to evaluate students' understanding of key concepts and skill development. By implementing the constructivist approach of the 5E lesson model in an innovative and creative way, students were immersed in mathematical content and participated at a higher cognitive level while having fun! This study is a postion paper that did not bring out any findings.

Ilyas, Rawat, Bhatti, and Malik (2013) investigated on “Effect of teaching algebra through social constructivist approach on 7th Graders’ Learning outcomes in Sindh (Pakistan)” and the following observations were made. The study involved quasi – experimental design. All public sector male seventh graders of District Jamshoro comprised the target population of the study; and two existing in-tack classes (sections A and B) of 7th graders (2010 – 2011) of a Government Boys High School of District Jamshoro were selected as sample for control and treatment groups respectively. The quantitative data were collected from both groups through Pre and Post tests and were analysed using t-test to find out statistical difference between control and treatment groups. Two patterns of analyses were carried out: Pretest scores analysis of both control and treatment groups to find out and ensure homogeneity between the selected in-tack groups in terms of previous knowledge and understanding; and post test scores analysis of both groups to determine the effect of treatment on learning outcome of the students. The exercise of the study involves application of algebraic concepts to daily life through solving word problems using operations of variables. The treatment involved Vygotsky’s three constructivist processes of modeling, scaffolding and collaboration. The observatory findings from two students of control group revealed: The mathematics teacher solved the word problems on the blackboard using one-way lecture. He occasionally involved one or two bright students by asking a few yes/no or simple questions leaving the remaining majority uninvolved in teaching learning process. The researchers found out that social constructivist approach worked better than the existing one-way teaching. It not only yielded better learning outcomes, but also provided opportunities for students to interact with others, to share one's ideas and listen to others (peer or teacher) points of view, to develop social interaction and communication skills, and to learn collaboratively in a free friendly environment. This study is socialistic constructivist with no application of 5Es.

The study titled "The effect of 5E learning cycle model in teaching Trigonometry on students' academic achievement and the permanence of their knowledge" was written by Tuna and Kacar (2013). From the study, the following information are extracted. The experimental research was chosen as randomized pretest-post-test control group design. There existed two groups formed by random assignment. One of them was used as an experimental, the other as a control group. The students in the experimental group took the course about trigonometry from researcher in an environment where the 5E learning model based on the constructivist approach is used. The students in the control group took the same course without intervention of the researcher, from their mathematics teacher in an environment where the activities of official mathematics curriculum are used. The working group of this research consisted of 49 students in 10th grade registered for spring semester of 2009 – 2010 academic years. In the experimental group there were 25 students (13 girls, 12 boys) and in the control group, there were 24 students (12 girls and 12 boys). Consisting of 28 questions, a test was prepared for measuring each acquisition of trigonometry. In the analysis of the collected data, students in the experimental group, where the 5E learning model based on the constructivist approach was used were found as more successful than those in the control group. Mathematics teachers should provide opportunities to students for learning by exploring and reaching themselves to knowledge. The students should be asked to give reasons of solving steps of the given problem. Whenever possible, the passage to the application should be done directly by students and also during the application, the mistakes and errors should be found directly by them. Teachers should only orientate students, help them. This study worked on trigonometry while the current study researched on algebra.

Kauru (2014) researched on "Impact of Constructivist teaching strategy on students' academic achievement retention and attitude towards trigonometry in Senior Secondary Schools in Kaduna State, Nigeria" and the following observations are made. The study adopted Quasi-experimental with Pre-test - Post-test Control group design. The study used SSII students in Kaduna State with a population of 20,154 in 2012/2013 academic session. A stratified random sampling technique was employed to select 400 students as sample size. Trigonometry Achievement Test (TAT) was used to measure academic achievement of the students, Trigonometry Retention Test (TRT) to measure the retention levels of the students and Trigonometry Attitude Questionnaire (TAQ) to check attitudinal change in students views on trigonometry. The result of the study indicated that constructivist teaching strategy significantly enhanced the academicachievement, retention ability and attitude of students towards trigonometry. This study carried out investigation on trigonometry while the current study researched on algebra.

In the research conducted by Andam, Okpoti, Obeng-Denteh and Atteh (2015) titled "The Constructivist approach of solving word problems involving algebraic linear equations: The case study of Mansoman Senior High School, Arnansie West District of Ghana", the following observations are made. The research design model for the paper is an action research. The pre-test and post-test were administered to the students to find out their strength and weaknesses and to findout how far the intervention activities would improve the performance respectively. Both the pre-test and post-test involved ten questions which were marked over 50 marks and was conducted in the normal class-teaching period of 45 minutes, bur had different set of similar question. The school had a population of 566 students (352 males and 214 females). The second year students had population of 295 and the rest were in first year. A random sample of 40 second year students (24 males and 16 females) were chosen for the research. The statistical analysis showed that the intervention activities helped to improve students' competence in solving algebraic word problems. This indicated that teachers have been teaching the solving of algebraic word problems in an organized form rather than allowing the students to create their own understanding themselves. The intervention led to students developing a more positive attitude towards mathematics in general. This study did not include application of 5Es.

Owusu (2015) conducted research on the topic "The Impact of Constructivist based teaching method on Secondary School Learners errors in

Algebra" and the following observations are extracted: The research design is that of Quasi – experiment research approach with a non-equivalent control group design. The targeted population was grade 11 mathematics learners from Quintile 2 schools and had population of 550 students. The sample of the study was one grade 11 mathematics teacher and 78 mathematics learners in Grade 11. The primary data collection instruments for the study were Algebra Concept Achievement Test (ACAT) and lesson observation schedules. The achievement test (ACAT) was developed to determine and evaluate learners' errors in four conceptual areas in algebra namely, variables, expressions, equations and word problems before and after intervention. The post-test was used to determine participants' initial errors in algebra before intervention. A post-test was given at the end of intervention to ascertain any change in participants' errors in algebra over a four-week period. The same test was administered to both the experimental group and the control group. The lesson observation schedule was used in order to observe the aspects of traditional teaching method (TTM) and Constructivist – based teaching method (CBTM) in relation to the exposition of learners' errors and also how each instruction tends to provide treatment for the observed learners' errors. The researcher observed the lessons in the control school more than once so as to trace the treatment activities. Lesson observations in the experimental group were on-going during the course of the experiment. The main areas of focus during the lesson observations were the format of instruction, how the teacher used teaching and learning resources, how the teacher discovered learners errors, how the teacher provided treatment for the observed learners' errors, the arrangement of the learning setting to facilitate the exposition and subsequent treatment of learners' errors. The same content was taught in both the control and experimental groups. Both groups had equal number of instructional periods. Descriptive statistics was used to obtain the difference between means and standard deviation, for each group on each dependent variable. The inferential statistics used for testing the research hypotheses was the independent samples t-test and the paired-samples t-test. To determine the statistical significance of the mean difference in order to affirm the effectiveness of the CBTM, the pre-test and post-test scores were compared using a paired-sample t-test at the significance level of 0.05. The concluding stage of the lesson was meant for reflection where group discussion of activity took place and success rate of the lesson was evaluated. The lesson concluded with more-tasks given as homework. This research did not incorporate application of 5Es.

The reviewed literatures are mostly, foreign based. The few ones that are Nigeria based never researched on Algebra as a branch of secondary school mathematics. The present study on algebra will add its own contribution in the area of constructivist teaching strategy. With more and more researches on constructivist approach, time would come for Nigeria to embrace it.

2.13 Implications of Literature Reviewed on the Present Study

Constructivist teaching strategy has been tested, trusted and adopted all over the world; but is still not yet well embraced in Nigeria. Nigerian Mathematics Educators need to research very well on the teaching strategy so that it can be well adopted in Nigeria mathematical subjects. The world is now changing the locus of control of teaching/learning from the teacher to the learner. Hence, the need of constructivist approaches to help students become more mathematically literate.

The reviewed literature reveals that we can minimize the use of traditional method not completely erased as recommended by United States National Mathematics Advisory Panel convened by George W. Bush that elements of both traditional mathematics (such as mastery of basic skills and some direct instruction) and reform mathematics (such as some student centred instruction and an emphasis on conceptual understanding and problem-solving skills) need to be combined for best instruction.

In the reviewed literature, it is observed the need to utilize algebra in every aspect of mathematics and other science subjects. Teacher professional development should be well enhanced in order to cope with the demands of constructivism. Teachers should not under estimate the conceptual leap required for operating on unknowns and variables.

In the reviewed studies, the applications of 5Es (Engage, Explore, Explain, Elaborate, Evaluate) in Constructivism teaching strategy are rare. Hence the present study wants to investigate how 5Es can readily be applied in constructivist teaching strategy in algebra.

Students learning in constructivist approach do have some impact on student's performance in mathematics in terms of their understanding and applicability and children are able to integrate their learnt concepts to construct knowledge. Through students' presentation, they shared their opinions and learn from each other. As students attain their goal, they see that there are capable of performing certain tasks and their confidence with respect to future learning is enhanced.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

The study determined the effect ofsocialist constructivist teaching strategy on attitude, performance and retention in algebra among Junior Secondary School students in Kogi State, Nigeria. To achieve this goal, data were collected using performance and attitude tests. The chapter is presented under following subheadings:

3.2 Research Design

3.3 Population

3.4 Sample and Sampling Technique

3.5 Instrumentation

3.6 Socialist Constructivism Teaching Strategy Guide

3.7 Control Group Teaching Guide

3.8 Validation of Instrument

3.9 Pilot Testing

3.10 Reliability of the Instrument

3.11 Administration of Instrument

3.12 Procedure for Data Collection

3.13 Procedure for Data Analysis

3.2 Research Design

The study used Quasi-experimental design involving pretest, post-test and post post-test in order to investigate the effect of independent variable (Socialist constructivist teaching strategy) on the dependent variables (attitude, performance and retention). Classes were assigned to experimental and control groups.Initially, the Experimental Group (EG) and Control Group (CG) were pre-tested (O_1A_1) with test items in algebra and Algebraic Attitude Questionnaire Scale (AAQS) in order to establish their common background for the study. After the pre-test, the experimental group received treatment (X_1) and the control group received no treatment (Xo). After that the two groups were subjected to post-test (O_2A_2) with test items in algebra and Algebraic Attitude Questionnaire Scale (AAQS) to check possible attitude change after application of treatment.After two weeks post-post-test (O_3) was given to the two groups in order to ascertain their retention levels. The research design is illustrated in figure 3.1.

EG: $\longrightarrow O_1A_1X_1O_2A_2 \longrightarrow O_3 \quad \longrightarrow \quad \longrightarrow$

CG: $\longrightarrow O_1A_1Xo \longrightarrow O_2A_2 \; O_3 \longrightarrow \quad \longrightarrow$

Figure 3.1: Research Design Illustration

Keys:

EG: Experimental Group

CG: Control Group

O_1: Pretest with APTA

A_1 Pretest with AAQS

O_2: Post-test with APTB

A_2: Post-Test with AAQS

X_1 Treatment

X_O: No Treatment.

O_3: Retention test (to ascertain their retention level)

3.3 Population

Public secondary schools in Kogi State are categorized into two boards namely Teaching Service Commission (TSC) and Science/Technical Education Board (STEB). STEB comprises all the science and technical secondary schools in the state and TSC controls all other Public Secondary Schools in the State. The present study used Junior Secondary Schools under TSC which are 241 in number with total students population of 29,433(14,973 male and 14,460 female) across the 8 Educational Zones in Kogi State. This is because they have similar staffing situation and infrastructure availability. Minimum teaching qualification is Nigeria Certificate in Education (NCE) in Mathematics. Classroom and teaching resources are similar in the schools. Funding of the schools is from the same government source. The population of the study includes all the Junior Secondary School students 2017/2018 academic session in Kogi State with students total population of 29,433 given in Table 3.1.

The population is within average age of 11 – 14 years old and mostly indigene of Kogi state. Mathematics is a compulsory subject for every member of the population. They operate the same mathematics syllabus and uniform school calendar.

Table 3.1: Summary of 2017/2018 School Enrolment by Educational Zones in Kogi State

Educational Zone	JSS 1			JSS 2			JSS 3			JSS TOTAL		
	M	**F**	**T**	**M**	**F**	**T**	**M**	**F**	**T**	**M**	**F**	**T**
Ankpa	967	793	1760	813	697	1510	613	552	1165	23932042		4435
Dekina	1285	1234	2519	1148	1097	2245	909	887	1796	3342	3168	6510
Idah	930	1025	1955	919	1037	1956	773	947	1720	2622	3009	5631
Isanlu	378	387	765	429	343	772	396	374	770	1203	1104	2307
Kabba	504	396	900	518	366	884	400	355	755	1422	1117	2539
Lokoja	481	601	1082	646	550	1196	545	532	1077	1672	1683	3355
Ogaminana	376	355	731	333	314	647	208	224	432	917	893	1810
Okene	568	543	1111	485	501	986	349	400	749	1402	1444	2846
Total: =	**5,489**	**5,334**	**10,823**	**5,291**	**4,905**	**10,196**	**4,193**	**4,271**	**8,464**	**14,973**	**14,460**	**29,433**

Source: Kogi State Teaching Service Commission Lokoja. (2017)

3.4 Sample and Sampling Technique

Multi-stage random sampling technique was used in the study. There are eight educational zones (Ankpa, Dekina, Idah,Isanlu, Kabba, Lokoja.Ogaminana and Okene) in Kogi State. Due to insecurity in the state, two educational zones (Ogaminana and Okene) were selected from the eight educational zones in Kogi State. In each of the selected Educational Zones two Secondary Schools (mixed) were randomly selected, `giving a total of four Junior Secondary Schools for the study. According to the wish of the research assistants during the organized research workshop, an arm of JSS three class was used in the selected Secondary School. This led to a total of 169 students (77 male and 92 female) that served as the research sample. In each educational zone of the study, one school was meant for control group and the other for experimental group by randomization.Table 3.2 depicts the selected research sample of the study.

Table 3.2: Sample of the Study

Educational Zone	Selected Schools	M	F	Total
Ogaminana	A	21	19	40
	B	21	23	44
Okene	C	19	21	40
	D	16	29	45
Total:		**77**	**92**	**169**

The sample size of 169 is justified by Roscoe(1975) that in an experimental research, samples of 30 or more are recommened.

3.5 Instrumentation

Four instruments were used for this study. They are Algebra Performance Test A (APTA) for pre-test, Algebra Performance Test B (APTB) for post-test, Algebra Retention Test, (ART) and Algebraic Attitude Questionnaire Scale (AAQS) for pre-test and post-test. APTA, APTB and ART have similar format with slight variations in questions.

3.5.1 Algebra Performance Test A (APTA):

They were developed by the researcher and validated by three mathematics experts. APTA is divided into two sections. Section A consisted of Bio data, while Section B contains items on Algebra concepts. This instrument wasmeant for pre-test in order to determine the initial algebra background of the students. It comprises of forty multiple choice questions with five options (A, B, C, D and E). The questions cover the algebra topics selected for this study. Objective questions were used in order to cover all the topics selected for the study (See Appendix A).

3.5.2 Algebra Performance Test B (APTB):

They were designed by researcher and validated by three experts in Mathematics. They were designed to check the algebra performance of the two groups (experimental and control) after the application of treatment to experimental group.The instrument consisted of two sections (A and B), section A dealt with biota with section B multiple choice questions in algebra. The respondents were given 1½ hours to answer the questions.It consisted of forty multiple choice questions with five options (A,B,C,D,E).(See Apendix B).

3.5.3 Algebra Retention Test (ART):

They were designed by the researcher and validated by three experts in Mathematics. It was designed to check the retention level of the students in both experimental and control groups.The instrument was in two sections (A and B) section A sought for biodata and section B consisted of multiple choice questions. The respondents were given 1½ hours to answer the questions. The instrument was administered after two weeks in which post-test have been taken. The test items are forty multiple choice questions with five options (A,B,C,D,E).(See Appendix C)

3.5.4 Table of Specification Based on Bloom's Taxonomy:

Bloom (1956) shows that table of specifications identifies the achievement domains being measured and ensures that a fair and representative sample of questions appear on the test.

The selected algebra topics with respective behavioural objectives for this study are displayed on Table 3.3

Table 3.3: Selected Algebra Topics for the Study

Topics	Sub topics	Objectives	No. of week for teaching
Algebraic Expressions	Simplification	The students should be able to simplify any form of algebraic expressions.	1
	Expansion	The students should be able to expand any given algebraic expressions.	1
	Factors and Factorization	The students should be able to identify appropriate factors of Algebraic expressions	1
Simple Equations and word problems	Simple Equations	The students should be able to solve problems on simple Equations.	1
	Word Problems	The students should be able to translate word problems into algebraic equations and solve accordingly	2

Table 3.3 indicates that six weeks were required to teach the selected algebraic topics to the two groups (Control and Experimental). This led to the formation of table of specification based on Bloom's taxonomy.

Table 3.4: Table of Specification Based on Bloom's Taxonomy

Content Area	Cognitive Domain						
	Knowledge	Comprehension	Application	Analysis	Synthesis	Evaluation	Total
Simplication of Algebric Expressions	1	2	5	0	0	0	8
Expansion of Algebraic Expression	0	5	3	0	0	0	8
Factors and Factorization of Algebraic Expressions	0	6	1	0	0	0	7
Simple Equation	0	8	0	0	0	0	8
Word Problems On Simple Equation	0	2	7	0	0	0	9
Total:	1	23	16	0	0	0	40

3.5.5. Algebraic Attitude Questionnaire Scale (AAQS):

The Algebraic Attitude Questionnaire Scale was adapted by the researcher and used in order to determine whether students have favourable predisposition or otherwise towards algebra. It employed Socialist Constructivist Teaching Strategy to verify if positive or negative attitude could be developed towards algebra. There were twenty items in the instrument with 4- point attitude scale (Strongly Agree, Agree, Disagree and Strongly disagree). The Scale is graded 4 – 1 mark respectively for positive statements and 1 – 4 marks for negative statements.

3.6 Socialist Construction Teaching Strategy Guide:

The focus of constructivist teaching strategy is to involve the learner from beginning to the end of lesson. At the instruction phase of the lesson, Owusu (2015) divided the lesson into three stages: Introduction, the body of the lesson and conclusion. At the introduction stage, the teacher introduces the topic to class, explains the key terms and concepts; asks questions to assess learners' prior knowledge.

At the body stage of the lesson, learners in their groups are given the example sheets to discuss the solution steps while the teacher monitors group discussion. During this stage self-explanation activity and probing take place. At this stage of instruction the teacher carefully monitors the group work and whole-class discussion. This is necessary so as to intervene and redirect the learners to correct their mistakes and misunderstandings.

The concluding stage of the lesson is meant for reflection of the lesson where group discussion of activity has taken place and success rate of the lesson is evaluated. The lesson is concluded with more tasks given as homework.

The general format of a Socialist constructivist-based lesson plan used for this study is shown on Table 3.5.

Table 3.5: A Socialist Constructivist-Based Lesson Plan in the Experimental Group

LESSONS STAGES	PLANNED ACTIVITIES
Introduction (10 minutes)	Teacher introduces topic to class Explanation of key terms and concepts Questions asked to access learners' prior knowledge of the topic and Teacher establishes the basic errors and algebraic skills of learners
Body (20 minutes)	Learners arranged in groups Example sheets given to groups Learners discuss solution steps Teacher monitors group discussions and Self-explanation activity and probing takes place.
Conclusion (10 minutes)	Reflection Classwork/group discussion of activities Evaluation of success rate Reflection on the lesson with more problems/tasks, Home work is given.

Source: Adapted Owusu (2015)

3.7 Control Group Teaching Guide

In traditional Method of teaching, the teacher dominates the lesson and all the students are not actively engaged throughout the lesson. The lesson was divided into three stages namely introduction, the presentation of the lesson and conclusion. At the introduction stage, the teacher introduces the topic to class, explains the key terms and concepts, ask questions to assess learners' entry knowledge. At the presentation stage, the teacher gives examples on the topic. In case the students ask question, he answers them. The teacher can write some questions on the board for the able students to solve. At the concluding stage of the lesson, the teacher gives homework for the students to solve.

The general format for a traditional-based lesson plan used for this study is displayed on Table 3.6.

Table 3.6: A Traditional-Based Lesson Plan Guide in the Control Group.

LESSON STAGES	PLANNED ACTIVITIES
Introduction (10 minutes)	The teacher introduces the topic to the class. The teacher explains key terms and concepts. Question asked to assess learner's entry knowledge
Presentation (20 minutes)	The teacher gives example on the topic. Students exercises written on the board for the capable students to solve.
Conclusion (10 minutes)	The teacher gives homework for the students.

3.8 Validation of Instruments:

3.8.1 Algebra Performance Test A (APTA)

This was subjected to face and content validity. The validity was carried out by a Chief Lecturer with Ph.D. in Mathematics at Federal College of Education Okene and two senior mathematics teachers at Secondary School level with B.Sc. (Ed) mathematics qualification and minimum of fifteen years teaching experience. The validity checked the content coverage, difficulty level and general editorial exercise. Their combined valued suggestions led to final production of the instrument.

3.8.2 Algebra Performance Test B (APTB)

This was subjected to face and content validity. The validity was carried out by a Chief Lecturer with Ph.D. in Mathematics at Federal College of Education Okene and two senior mathematics teachers at Secondary School level with B.Sc. (Ed) mathematics qualification and minimum of fifteen years teaching experience. The validity checked the content coverage, difficulty level and general editorial exercise. Their combined valued suggestions led to final production of the instrument.

3.8.3 Algebra Retention Test (ART)

This was subjected to face and content validity. The validity was carried out by a Chief Lecturer with Ph.D. in Mathematics at Federal College of Education Okene and two senior mathematics teachers at Secondary School level with B.Sc. (Ed) mathematics qualification and minimum of fifteen years teaching experience. The validity checked the content coverage, difficulty level and general editorial exercise. Their combined valued suggestions led to final production of the instrument.

3.8.4 Algebraic Attitude Questionnaire Scale (AAQS)

This was subjected to face and content validity. The validity was carried out by a Chief Lecturer with Ph.D. in Mathematics at Federal College of Education Okene and two senior mathematics teachers at Secondary School level with B.Sc. (Ed) mathematics qualification and minimum of fifteen years teaching experience. The validity checked the content coverage, difficulty level and general editorial exercise. Their combined valued suggestions led to final production of the instrument.

3.9 Pilot Testing

The Pilot teaching was carried out at Ebira Community Secondary School Ogaminana in Ogaminana educational zone, Kogi State which did not participate in the real research sample. A sample of 40 students (18 male and 22 female) was used for the Pilot Study. The purpose of the Pilot testing was to establish or determine the appropriateness of the instruments, adequacy or inadequacy of the time allowed for students to complete the given tasks, validity, reliability and item difficulty of the research instruments. On the basis of the results from Pilot study the coefficient of reliability was estimated as stated in Section 3.11 and necessary amendments were made to APT and AAQS to suit the students' level as well as the time allocated was adjusted to enable average students finished the given tasks.

3.10Item Analysis

Before Pilot teaching, 60 objective questions were set from the selected Algebra topics of the study and eventually chose 40 objective questions based on the item discrimination index.It was deduced that any item with discrimination index more than 0.6 is difficult for the students concerned and discrimination index less than 0.4 is very simple. Interval of 0.4 to 0.6 was considered to be within ability level of the students (Sambo, 2008). The discrimination index on Table 3.7 was used to choose the 40 questions for APT.

Table 3.7: Discrimination Index Table

Topics	Discrimination Index Table	Total
Simplification of Algebraic Expression	0.51 0.45 0.56 0.49 0.44 0.50 0.46 0.47	8
Expansion of Algebraic	0.42 0.46 0.58 0.47 0.43 0.53 0.56 0.47	8
Factors and Factorization of Algebraic Expressions	0.49 0.51 0.42 0.58 0.53 0.530.48 0.52	7
Simple Equations	0.52 0.44 0.54 0.46 0.50 0.53 0.46 0.49	8
Word Problems on Simple Equations	0.51 0.48 0.41 0.44 0.56 0.42 0.48 0.41 0.49	9
		40

3.11 Reliability of the Instruments

The APT and AAQS were administered on a sample of 40 students in a school that was not part of the real study.

3.11.1 Algebra Performance Test

The performance tests are in interval scale. Test-Retest method using Pearson Product Moment Correlation Coefficient, the reliability was found to be 0.80. The Test-Retest was carried out at an interval of two weeks. The reliability coefficient indicated that the designed instrument was within the ability of the research sample.

3.11.2 Algebraic Attitude Questionnaire Scale

The algebraic attitude questionnaire scale is an ordinate interval. Split-halves method and using Spearman rank order correlation coefficient, the reliability was found to be 0.97. The reliability coefficient indicated that the was within the ability of the research sample.

3.12 Administration of Instrument

A week before the start of the research, five-day workshop wasorganized for the four research assistants enmarked for the study. This wasto enable us go through the research manual for uniformity of implementation. Three days was used for the experimental group research assistants. This was because they had more requirements for the research. Two days of the workshop was meant for control group research assistants.

Before the test items administration, the researcher needed to have a one-to-one contact with all the research assistants. This was to groom them with their expectations and that of the students in the research study. Both the control and experimental groups spent five weeks to teach the selected algebra topics for the study. Two days before the beginning of the research period, all the required materials were delivered to the research secondary schools. During the six weeks engagement the researcher went round the selected schools to check if things were in progress as planned.

3.13 Procedure for Data Collection

Four instruments (APTA, APTB,ART, AAQS) were used for this study. Each of APTA, APTB, ART comprises of forty multiple choice questions with five options (A, B, C, D, E) in each question for students to choose the one they solve to be the correct one. They must do their rough work at the back of the question papers. Each question earns two marks and the maximum obtainable score is 80.

AAQS consists of twenty attitudinal questions with four options (strongly agree, agree, disagree, and strongly disagree) for students to sincerely choose their favourable options.

Before the commencement of six-week teaching in the control and experimental groups, APTA was applied to the students as pre-test and AAQS applied to the students in order to verify their background feelings about algebra. At the end of the six weeks teaching, APTB was applied to check students' progress as a result of the applied research instrument and AAQS applied to check the students'later feelings about algebra. One period of lesson was used on weekly-basis that led to a total of six weeks teaching duration. After two weeks of the completion of the research treatment, ART was applied to verify the students' retention ability.

3.14 Procedure for Data Analysis

The analysis was carried out according to the stated study hypotheses:

HO_1: There is no significant difference in the attitudinal change of students towards algebra after beingtaught with socialist constructivist teaching strategy at JSS Level in Kogi State. Mann-Whitney teststatistic was used to analyse the collected data for this hypothesis.

HO_2: There is no significant difference in the performance of students taught with constructivist teaching strategy and those taught with traditional method at JSS level in Kogi State.

t-test for independent samples was used to analyse the collected data for this hypothesis.

HO_3: There is no significant difference in the mean retention capability of students taught algebra with constructivist teaching strategy and those taught with traditional method at JSS level in Kogi State.

t-Test for independent samples was used to analyses the collected data for this hypothesis.

HO_4: There is no significant difference in the attitudinal change of male and female students taught algebra using constructivist teaching strategy at JSS level in Kogi State.

Mann-Whitneytest statistic was used to analyse the collected data for this hypothesis.

HO_5: There is no significant difference in the mean performance of male and female students in algebra exposed to constructivist teaching strategy at JSS level in Kogi State.

t-test for independent samples was used to analyse the collected data for this hypothesis.

HO_6 There is no significant difference in the retention ability of male and female students taught algebra using constructivist strategy at JSS level in Kogi State.

t-test for independent sample was used to analyse the collected data for this hypothesis.

CHAPTER FOUR

DATA PRESENTATION, ANALYSIS AND DISCUSSION

4.1 Introduction

The study was set to assess the effect of socialist constructivist teaching strategy on attitude, performance and retention in algebra among junior secondary school students in Kogi State. In order to achieve the main focus, the study was structured along six objectives, research questions and null hypotheses respectively. Three instruments of performance scores (pre-test, post- test; and retention) and 20 – item test on attitude were used to collect data for the study. The chapter is organized under the following sub-headings:

4.2 Summary of Responses to Research Questions

4.3 Hypotheses Testing

4.4 Summary of the findings

4.5 Discussion of the findings.

4.2 Summary of Responses to Research Questions

This section is meant to verify the research questions of the study based on the collected data.

Question One: What is the effect of socialist constructivist teaching strategy on attitude of JSS students in Kogi state towards algebra?

To answer this question, rank test was used in Table 4.1

Table 4.1Mean rank test on effect of socialist constructivist teaching strategy on attitude of JSS students in Kogi State towards algebra

Ranks

Variable	**Groupings**	**N**	**Mean Rank**	**X^2 computed**	**X^2 critical**	Remarks
Attitude	Experiment Pretest	80	159.14	31.105	7,815	Positive effect of Socialist constructivist strategy on attitude. Post test has the highest score
	Experiment Posttest	80	224.01			
	Control Pretest	89	156.33			
	Control Posttest	89	142.99			
	Total	338				

The Mean rank statistics in Table 4.4 showed that differences exist in the attitudinal change of students towards algebra taught with constructivist teaching strategy and those taught with traditional method. Their computed Mean Rank attitude scores are 159.14, 224.01, 156.33 and 142.99 among the pretest Experimental, Post test experimental, Pretest Control and Post test Control respectively. This implies the students attitude change positively at the Post test Experimental when compared with the other groups, implying a Positive impact of constructivist strategy on attitude.

Question Two: How is the effect of socialist constructivist teaching strategy on the mean performance of JSS student in Kogi State in the learnt algebra?

To answer this question two, mean and standard deviation of the students scores were calculated in Table 4.2

Table 4.2: Descriptive statistics on difference in the mean performance of students taught with Socialist constructivist teaching strategy and those taught with traditional method.

Variable	Groups	N	Mean	Std.dev	Std Error	Mean Diff	Remarks
Performance	Experiment	80	48.300	3.865	0.432	7,750	Positive effect of Socialist constructivist strategy on students' performance
	Control	89	40.550	4.456	0.472		

The results of the descriptive statistics in table 4.2 revealed that difference exist in the mean performance of students taught with constructivist teaching strategy and those taught with traditional method. Their computed mean academic performances in algebra are 48.300 and 40.550 by experimental and control group students respectively, implying a mean difference of 7.750 in favour of the experimental group. This shows that Positive effect of constructivist strategy on students performance.

Question Three: Why is there influence of socialist constructivist teaching strategy on the retention level of JSS Kogi state students in algebra.

To answer this question, mean and standard deviation on the retention were used in Table 4.3.

Table 4.3: Descriptive statistics on difference in the mean retention of students taught with socialist constructivist teaching strategy and those taught with traditional method.

Variable	Groups	N	Mean	Std.dev	Std. Err	Mean Dif	Remarks
Mean retention	Experiment	80	57.825	6.639	0.7422	16.050	The constructivist strategy has positive influence on the students' retention level.
	Control	89	41.775	5.935	0.6291		

The results of the descriptive statistics in table 4.3 revealed that difference exists in the mean performance of students taught with constructivist teaching strategy and those taught with traditional method. Their computed mean academic performances in algebra are 57.825 and 41.775 by experimental and control group students respectively, implying a mean difference of 16.050 in favour of the experimental group. This shows that students taught algebra with constructivist strategy have significantly higher performance than their counterparts taught by conventional method. The Socialist constructivist strategy has positive influence on the retention level of the students.

Question Four: What is the influence of socialist constructivist teaching strategy on gender and attitude among JSS students towards the learning of algebra?

To answer this question, mean rank test were calculated and used in Table 4.4

Table 4.4: Mean rank test difference on the attitudinal change of male and female in experimental group.

Variable	Gender Groups	N	Mean Rank	X^2 computed	X^2 critical	Remarks
Attitude	Male Pretest	40	62.13	14.390	7,815	The Socialist constructivist strategy has positive influence on both male and female students
	Female Pretest	40	61.38			
	Male Posttest	40	94.55			
	Female Posttest	40	93.38			
	Total	160				

The Mean rank statistics showed that differences exist in the attitudinal change ofMale and female students taught algebra with Socialist constructivist teaching strategy. Their computed Mean Rank attitude scores are 62.13, 61.38, 94.55 and 93.38 among the Male Pretest, Female pretest, Male Post test and Female post test respectively. This implies the male and female students attitude change significantly at the Post test level when compared with their pretest scores, implying a significant attitudinal change has taken place as a result of male and female students taught algebra with constructivist teaching strategy.

Question five: What is the effect ofsocialist constructivist teaching strategy on gender and performance among JSSS students in algebra?

In order to answer the question, mean and standard deviation were calculated and used in Table 4.5.

Table 4.5: Difference in the performance level of male and female students' in experimental group

Variable	Groups	N	Mean	Std.dev.	Std.error	Mean Diff	Remarks
Performance	Male	40	48.7125	3.94495	.62375	0.825	The socialist constructivist strategy has positive effect on both male and female students.
	Female	40	47.8875	3.78846	.59901		

.

The results of the descriptive statistics in table 4.5 revealed that there is no significant difference in the mean performance of male and female students taught algebra with constructivist teaching strategy. Their computed mean performance in algebra are 48.7125 and 47.8875 by male and female students in experimental group respectively, implying an insignificant mean difference of 0.825 in favour of the male experimental group. This shows that both male and female students taught algebra with constructivist strategy have close level of mean performance.

Question Six: How is the effect of socialist constructivist teaching strategy on gender and retention ability among JSS students in algebra?

To answer this question, mean and standard deviation were calculated and used in Table 4.6.

Table 4.6Difference in the retention level of male and female students in experimental group.

Variable	Groups	N	Mean	Std.dev	Std.error	Mean Diff.	Remarks
Retention	Male	40	58.550	6.531	1.032	1.45	The socialist constructive strategy has positive effect on retention ofboth male and female students .
	Female	40	57.100	6.747	1.066		

The results of the descriptive statistics in table 4.6 revealed that there is no significant difference in the Retention level of male and female students taught algebra with constructivist teaching strategy. Their computed mean mark retention in algebra are 58.550 and 57.100 by male and female students in experimental group respectively, implying an insignificant mean difference of 1.45 in favour of the male experimental group. This shows that both male and female students taught algebra with constructivist strategy have close level of retention showing that the constructivist strategy is very effective for the retention level of both male and female students alike. The constructive strategy has positive effect on retention of both male and female students.

4.3. Hypotheses Testing

The statistical package of SPSS Version 23 was used to carry out the analysis. The six null hypotheses of the study were tested at 0.05 alpha level of significance.

Null Hypothesis One: There is no significant difference in the attitudinal change of students towards algebra after being taught with socialist constructivist teaching strategy.

To test this hypothesis, non parametric test of Mann Whitney was used since the attitude is non parametric viewed across Experimental pretest and Experimental post test, groupings, in order to determine attitudinal change.

Table 4.7: **Non parametric test of Mann Whitneyfor attitudinal change level of Experimental Group**

Variable	Test	N	Mean Rank	Sum of Ranks	Mann Whitney	Z-Score	P
Attitude	Pre-test	80	67.16	5372.50	2132.5	3.648	0.000
	Post test	80	93.84	7507.50			
Total:		**160**					

Outcome of the Mann-Whitney test showed that significance difference exists in the attitudinal change between the pretest and post test scores of the experimental students. This is because the calculated P-value of 0.00 is lower than the 0.05 alpha level of significance of the study. Also, at the pretest stage, the students had mean rank of 67.16 and Sum of ranks of 5372.50, while at post test stage, they had mean rank of 93.84 and Sum of ranks of 7507.50. This implies that their attitude significantly improved after applying treatment. Therefore the null hypothesis which states that there is no significant attitudinal change among the respondents as a result of the applied treatment is hereby rejected.

Hypothesis Two: There is no significant difference in the mean performance of students taught with constructivist teaching strategy and those taught with traditional method.

To test this hypothesis, the mean performance of the experimental and control groups were compared with independent-t-test.

Table 4.8: Summary of t-test for Experimental Group versus Control Group

Variable	Groups	N	Mean	Std.dev	Std. error	Mean Diff	df	t	t critical	P
	Experiment	80	48.300	3.865	0.432					
Performance						7.750	167	12.0	1.96	0.000
	Control	80	40.550	4.456	0.472					

P calculated <0.05, t computed > 1.96 at df 167

The results of the t-test independent statistics in Table 4.8 revealed that significant difference exist in the mean performance of students taught with constructivist teaching strategy and those taught with traditional method. This is because the calculated p value of 0.000 is lower than the 0.05 alpha level and the computed t value of 12.01is higher than the t critical value of 1.96 at df 167. Their computed mean academic performances in algebra are 48.300 and 40.550 by experimental and control group students respectively, implying a mean difference of 7.750 in favour of the experimental group. This shows that students taught algebra with constructivist strategy have significantly higher performance than their counterparts taught by conventional method. Therefore the null hypothesis which state that there is no significant difference in the mean performance of students taught algebra with social constructivist teaching strategy and those taught with traditional method, is hereby rejected.

Hypothesis Three: There is no significant difference in the mean retention level of students taught algebra with socialist constructivist teaching strategy and those taught with traditional; method.

To test this hypothesis, the mean retention of the experimental and control groups were compared using independent t-test as shown in Table 4.9

Table 4.9: t test independent statisticto analyse hypothesis three.

Variable	Groups	N	Mean	Std.dev	Std. error	Mean Diff	df	t	t critical	P
	Experiment	80	57.825	6.639	0.7422					
Retention						16.050	167	16.5	1.96	0.000
	Control	89	41.775	5.935	0.6291					

P calculated <0.05, t computed > 1.96 at df 167

The results of the independent t-test statistic in Table 4.9 revealed that significant difference exists in the mean performance of students taught with socialist constructivist teaching strategy and those taught with traditional method. This is because the calculated p value of 0.000 is lower than the 0.05 alpha level and the computed t value of 16.5 is higher than the t critical value of 1.96 at df 167. Their computed mean academic performances in algebra are 57.825 and 41.775 by experimental and control group students respectively, implying a mean difference of 16.050 in favour of the experimental group. This shows that students taught algebra with socialist constructivist strategy have significantly higher performance than their counterparts taught with conventional method. Therefore the null hypothesis which states that there is no significant difference in the mean retention of students taught algebra with constructivist teaching strategy and those taught with traditional method, is hereby rejected.

Hypothesis Four: There is no significant difference in the attitudinal change of male and female students taught algebra with socialist constructivist teaching strategy.

To test this hypothesis, non parametric test of Mann Whitney was used since the attitude is non parametric viewed across Male and Female in order to determine their attitudinal change.

Table 4.10: Mann Whitney, non-parametric test to check male and female students' attitudinal change in the Experimental group.

Variaable	Test	N	Mean Rank	Sum of Ranks	Mann Whitney	Z-Score	P
	Male	32	41.59	1931.00	733.00	0.344	0.75
Attitude	Female	48	40.77	1929.00			
	Total:	80					

Based on the results of Mann Whitney in Table 4.13, there is no significant difference betweenmale and female in their attitudinal change after exposure to the research treatment. This is because the calculated P-value of 0.750 is greater than the 0.05 alpha level of significance of the study. Also the male group had mean attitudinal score of 41.59 and Sum of ranks of 1931.00, while the female group had mean attitudinal score of 40.77 and Sum of ranks of 1929.00. This shows that male and female groups had equivalent level of attitude. The Null hypothesis which states that there is no significant difference between male and female students attitudinal change in the experimental group is not rejected and hence it is retained.

Hypothesis five: There is no significant difference in the mean performance of male and female students in algebra exposed to socialist constructivist teaching strategy.

To test this hypothesis, the mean performance of the male and female students in experimental group were compared with the t test independent.

Table 4.11:t-test Independent statistic for Male and Female Students' Performance

Variable	Groups	N	Mean	Std.dev	Std. error	Mean Diff	df	t computed	t critical	P
	Female40 48.71253.9449562375									
Performance						0.82578		0.9541.96		0.343
	Male	4047.88753.78846			5.9901					

P calculated >0.05, t computed < 1.96 at df 78

The results of the independent t test statistic in Table 4.11 revealed that there is no significant difference in the mean performance of male and female students taught algebra using socialist constructivist teaching strategy. This is because the calculated p value of 0.343 is greater than the 0.05 alpha level and the computed t value of 0.954 is lower than the t critical value of 1.96 at df 78. Their computed mean performance in algebra are 48.7125 and 47.8875 by male and female students in experimental group respectively, implying an insignificant mean difference of 0.825 in favour of the male experimental group. This shows that both male and female studentstaught algebra using socialist constructivist strategy have very close mean performance showing that the socialist constructivist strategy is very effective for both male and female students. Therefore the null hypothesis which states that there is no significant difference in the mean performance of male and female students taught algebra using socialist constructivist teaching strategy, is hereby accepted and retained.

Hypothesis Six: There is no significant difference in the Retention level of male and female students taught algebra using socialist constructivist teaching strategy.

To test this hypothesis, the retention of the male and female students in experimental group were compared with the t test independent.

Table 4.12:t-test Independent statistic on the Retention of Male and Female Students

Variable	Groups	N	Mean	Std.dev	Std. error	Mean Diff	df	t computed	t critical	P
	Male	40	58.550	6.531	1.032					
Retention						1.45	78	0.977	1.96	0.332
	Female	40	57.100	6.747	1.066					

P calculated >0.05, t computed < 1.96 at df 78

The results of the independent t test statistic in Table 4.12 revealed that there is no significant difference exist in the Retention level of male and female students taught algebra using socialist constructivist teaching strategy. This is because the calculated p value of 0.332 is greater than the 0.05 alpha level and the computed t value of 0.977 is lower than the t critical value of 1.96 at df 78 . Their computed mean retention in algebra are 58.550 and 57.100 by male and female students in experimental group respectively, implying an insignificant mean difference of 1.45 in favour of the male experimental group. This shows that both male and female students taught algebra using socialist constructivist strategy have very close level of retention showing that the socialist constructivist strategy is very effective for the retention level of both male and female students.

Therefore the null hypothesis which state that there is no significant difference in the mean retention level of male and female students taught algebra using socialist constructivist teaching strategy is hereby accepted and retained.

4.4 Summary of the Findings

1. Significant differences exist in the attitudinal change of students towards algebra taught using socialist constructivist teaching strategy and those taught with traditional method. Their computed Mean Rank attitude scores are 159.14, 224.01, 156.33 and 142.99 among the pretest Experimental, Post test experimental, Pretest Control and Post test Control respectively. This implies that students attitude change significantly at the Post test Experimental when compared with the other groups, implying a significant attitudinal change took place as a result of teaching algebra using socialist constructivist teaching strategy.

2. Significant differences exist in the mean performance of students taught with socialist constructivist teaching strategy and those taught with traditional method. Their computed mean academic performances in algebra are 48.300 and 40.550 by experimental and control group students respectively, implying a mean difference of 7.750 in favour of the experimental group. This shows that students taught algebra using socialist constructivist strategy have significantly higher performance than their counterparts taught by conventional method.

3. Significant difference exista in the mean retention of students taught using socialist constructivist teaching strategy and those taught with traditional method. Their computed mean retention in algebra are 48.300 and 40.550 by experimental and control group students respectively, implying a mean difference of 7.750 in favour of the experimental group. This shows that students taught algebra using socialist constructivist strategy have significantly higher retention than their counterparts taught by conventional method.

4. Significant differences exist in the attitudinal change of Male and female students taught algebra using socialist constructivist teaching strategy. Their computed Mean Rank attitude scores are 62.13, 61.38, 94.55 and 93.38 among the Male Pretest, Female pretest, Male Post test and Female post test respectively. This implies the male and female students attitude changed positively at the Post test level when compared with their pretest scores, implying a significant attitudinal change took place as a result of male and female students being taught algebra using socialist constructivist teaching strategy.

5. There is no significant difference in the mean performance betweem male and female students taught algebra with constructivist teaching strategy. Their computed mean performance in algebra are 48.7125 and 47.8875 by male and female students in experimental group respectively, implying an insignificant mean difference of 0.825 in favour of the male experimental group. This shows that both male and female students taught algebra using socialist constructivist strategy have very close mean performance showing that the socialist constructivist strategy is very effective for the mean performance of both male and female students.

6. There is no significant difference in the Retention level of male and female students taught algebra using socialist constructivist teaching strategy. Their computed mean retention scores in algebra are 58.550 and 57.100 by male and female students in experimental group respectively, implying an insignificant mean difference of 1.45 in favour of the male experimental group. This shows that both male and female students taught algebra using socialist constructivist strategy have similar level of retention showing that the socialist constructivist strategy is very effective for the retention level of both male and female students.

4.5 Discussion of the Findings

The first finding indicated that a significant attitudinal change taking place as a result of teaching algebra using socialist constructivist teaching strategy. This would eventually lead to better performance of the students in algebra. This is in line with Olaosebikan (2005) that poor attitudes in science subjects lead to poor achievement and poor achievement leads to not offering the subject. Ajayi, Lawani and Adeyanju (2011) verified that attitude predicts Mathematics achievement. This means that the more the students are interested in Mathematics the more they achieve in the subject. Also Bautista (2012) revealed that the students in the experimental group manifested better attitudes in algebraic word problem solving than their counterpart in the control group as reflected by their weighed mean score. Mahanta and Islam (2014) also indicated that attitude of students and achievements in Mathematics are positively correlated.

The investiageion by Bay, Bagceci and Cetin (2012) revealed that the change in problem solving levels of the exprerimental group was higher and more significant than the control group. This finding is in agreement with the current study where experiemental group had positive attitudinal change. In the study of Norton and Irvin (2001) students valued the classroom discourses within the classroom much more than they did in the usual (traditional method) mathematics learning experiences. This is in agreement with the positive attitudinal change in the present study. In a similar manner, Bautista (2012) indicated students who were exposed to constructive learning enivornment performed better and developed better attitude towards algebraic word problem solving tasks than the control group.

The second finding showed that students taught algebra using socialist constructivist strategy performed better than their counterpart under conventional method. This is an indication of the students' sensitivity to the treatment of the research study. Similarly, Ilyas, Rawat and Bhatti (2013) confirmed that Vygotsky's social constructivist approach worked better than our existing one-way teaching. Its not only yielded better learning outcomes but also provided opportunities for students to interact with others, to share one's ideas and listen to others (peer or teacher) point of view, to develop social interaction and communications skills and to learn collaboratively in a free and friendly environment. In a similar vein, Tuna and Kacar (2013) established that the 5E learning model based on the constructivist approach used in the experimental group was more effective in teaching trigonometry than the traditional methods used in the experimental group was more effective in teaching trigonometry than the traditional methods used in the control group. Ajai, Imoko and Okwu (2013) also confirmed that students taught algebra using Problem Based Learning (PBL) outperformed their counterparts taught using conventional method. The finding revealed the efficacy of the use of PBL in enhancing students' achievement in algebra. In a chain of similar findings Gambari, Shittu and Taiwo (2013) established that Students exposed to Cooperative Computer Instruction (CCI) performed better than those exposed to conventional method of instruction respectively.

The third finding is an affirmation that students taught algebra using socialist constructivist strategy had higher retention than their counterpart taught by conventional method. The students in the experimental group were given opportunities to engage, explore, explain, elaborate, evaluate and reached themselves to knowledge. In a similar findings; Kurumeh, Onah and Mohammed (2012) revealed that students taught with ethno mathematics approach had a significant mean retention score in statistics than their counterpart taught with conventional method. Also Tuna and Kacar (2013) observed a statistically significant difference between experimental and control group students' scores in the permanence test. The difference was in favour of the experimental group.

The fourth finding revealed that both male and female students in the experimental group had significant attitudinal change after exposure to the research treatment. But the male students had higher positive attitude change than the female students. This finding supports that of Mahanta and Islam (2014). But

Uwineza, Hakizimana and Uwamahoro (2018) showed that mathematics tends to be perceived as a male dominant domain both in teaching and learning.

The fifth finding portrayed that there is no significant difference in the performance of male and female students in the same experimental group. This shows that the research treatment had equivalent affect on the male and female students. The finding supports that Galadima and Yushau (2007); Clement, Benjamin and David (2013); Gambari, Shittu and Taiwo (2013). But the finding of Ginga and Zakariya (2020) showed that male students outperformed female students when exposed to the same instructional strategy. In another vein, Saleh, AbdulRahman (2016) found out that girls performed better than boys in terms of achievement in algebra in all types of schools.

But Maliki, Ngban and Ibu (2009) reported that male students performed better than their female counterparts and Saleh (2016) showed that girls out performed boys on the study of students' achievement in algebra. It can be observed that performance in mathematics is a function of method rather than gender. Both sexes are capable of competing and collaborating in classroom activities

The sixth finding showed that the male and female students in the experimental group had equivalent level of retention. This is a further indication that the research treatment had similar influence on the male and the female. In a similar trend; Kurumeh, Onah and Mohammed (2012) revealed that both male and female students in the experimental group benefitted and retained statistics concepts more in the instruction than their counterpart under the conventional method. The difference between the retention mean score of male and female in experimental group is statistically not significant. This also in agreement with Ajai and Imoko (2015) that deduced that male and female students taught algebra using problem-Based learning did not significantly differ in achievement and retention scores. This is an indication that male and female students are capable of competing and collaborating in Mathematics.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

The concluding chapter of the study is organized under the following format:

5.2 Summary of the Study

5.3 Conclusions

5.4 Contributions to Knowledge

5.5 Recommendations

5.6 Limitations of the Study

5.7 Suggestions for future Studies

5.2 Summary of the Study

The study titled “effect of Socialist Constructivist teaching strategy on attitude, performance and retention in algebra among junior secondary school students in Kogi state, Nigeria” was presented in five chapters.

Algebra is a branch of mathematics that operates with numbers and letters. Every other branch of mathematics applies algebra in way or the other and yet it is not well understood by most secondary school students. in support of this, the WAEC chief examiner in 2013 and 2015 gave report on the students poor performance in algebra questions. Hence the present study set out to investigate the effects of soicalist constructivist teaching stratagey on attiude, performance and retention in algebra among Junior Secondary School students in Kogi state, Nigeria. Socialist constructivist teaching strategy was reveiwed with respect to mathematics, algebra, geometry, trigonometry, attiude, achievement, retention and gender.

In the study, six research questions and six research hypotheses were used to analyse the collected data. Eventually the first three hypotheses were rejected and the remaining three were retained. All the rejections and retentions were in favour of the experimental group.

5Es (Engage, Explore, Explain, Elaborate, Evaluate) were used to guide the experimental group. Two Educational Zones in Kogi State were used for the research data.

5.3. Conclusions

On the basis of the outcome of the study the following basic conclusions were deduced:

The results of the hypotheses showed that Socialist Constructivist Teaching Strategy improved the attitude, performance and retention level of students in Algebra. Organizing a socialist constructivist teaching strategy is not only difficult for classroom teachers but requires active intellectural and endurance of the students. The strategy made the students to learn the same concepts at the same time. The strategy was friendly to both male and female students. The injection of 5Es (Engage, Explore, Explain, Elaborate, Evaluate) in the teaching strategy made the students to be mentally alert throughout the lesson.

5.4 Contributions to Knowledge

Based on the findings of the study, it is established that

(1) The use of 5Es (Engage, Explore, Explain, Elaborate and Evaluate) in the experimental group makes the study different from other forms of socialist constructivist teaching strategy.

(2) The teaching manual for the experimental group is unique and useful to Mathematics teachers during mathematics lessons.

(3) The research is gender friendly and hence promotion of healthy competition between male and female.

5.5 Recommendations

The following basic points are given out as recommendations that will enhance the performance, attitude and retention ability of JSS students towards the learning and teaching of algebra in Kogi State.

1. The school authority should encourage students positive attitudinal change towards the learning of mathematics by giving prizes to the deserving ones.
2. Schools should organize seminars, workshops, in-service training for Mathematics teachers in order to improve their methods of teaching.
3. Students should constantly practise the study skill questions and revise algebra very constantly in order to improve their retention ability levels
4. The teachers of mathematics should use the suitable teaching methods for students by applying different forms of socialist constructivist teaching strategy like class discussions, modelling, scattolding, field trips, films, experimentation and others.

5. Mathematics teachers should encourage the students to embrace socialist constructivist teaching strategy because the activities are interactive and students centered.

5.6 Suggestions for Future Studies

Research work is a continous process and hence the following topics are suggested for future investigation

(1) Effect of George Polya problem solving strategy on attitude and performance of Senior Secondary School student in Algebra in Kogi State,

(2) Effects of Reciprocal Peer Tutoring (RPT) on NCE Mathematics in Kogi State.

(3) An investigation into the relationship between algebra and each other branch of Mathematics at Secondary School level.

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Appendix A

Algebra Performance Test A (APTA) – Pre-Test

INSTRUCTION: Attempt all the questions. Each question is followed by five options. Solve and choose the correct option for each question

GENDER: Male [ ] Female [ ] TIME ALLOWED: 1 ½ hours

Write the name of your school: ____
____

(1) Simplify the expression $2(3a + 2) – 2(a + 3)$
(a) $4a + 6$ (b) $6a + 6$ (c) $6a – 6$ (d) $4a + 2$ (e) $4a -2$

(2) Expand $(3a + 2)^2$
(a) $9a^2 – 12a – 4$ (b) $9a^2 + 12a – 4$ (c) $9a^2 + 6a + 4$
(d) $9a^2 + 12a + 4$ (e) $9a^2 – 12a + 4$

(3) Factorize $x^2 – 4x + 3$
(a) $(x – 1) (x – 4)$ (b) $x + 1) (x + 3)$ (c) $(x + 1) (x – 4)$
(d) $(x – 1) (x + 3)$ (e) $(x – 1) (x – 3)$

(4) Solve the equation $x + 7 = 19 + 2x$
(a) -12 (b) 28 (c) 26 (d) -26 (e) 12

(5) I think of a number. I double it. My result is 58. What number did I think of?
(a) 58 (b) 28 (c) 29 (d) 59 (e) 19

(6) Which of the following is a common factor of 2xy and 7xz?
(a) X (b) 14 (c) 2x (d) y (e) z

(7) Find the value of x if $3x – 8 = 10$

(a) 8 (b) 10 (c) 3 (d) 6 (e) 18

(8) Evaluate $\frac{2a^2 – 3b}{2a + b}$ if $a = 3$ and $b = -2$
(a) 8 (b) 6 (c) 4 (d) 2 (e) 3

(9) Find the coefficient of d in $(2-d) (3 +d)$
(a) 1 (b) 3 (c) 2 (d) -1 (e) -3

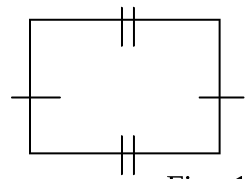
(10) A number is multipled by 6 and 4 is added. The result is 34. Find the number.

(a) 4 (b) 5 (c) b (d) 7 (e) 10

(11) If $\frac{2x}{5} = 6$, what is x?

(a) 15 (b) 30 (c) 10 (d) 3 (e) 13

(12) What is the perimeter of the following figure?



6cm

xcm Fig. 1

(a) $(6x + 2)$cm (b) $6(x + 2)$cm (c) $2(x + 6)$cm (d) $2(6 – x)$cm (e) 6xcm

(13) Expand $(2x – 1)^2$

(a) $4x–2$ (b) $4x^2-4x+1$ (c) $4x^2+4x+1$ (d) $4x^2$ $4x-1$ (e) $4x^2 + 4x – 1$

(14) Find two consecutive whole numbers such that five times the smaller number plus three times the greater number makes 59.

(a) 5 and 6 (b) 6 and 7 (c) 3 and 4 (d) 8 and 9 (e) 7 and 8

(15) Factorize $y^2 – 12l$

(a) (y-12l) (b) (y-1l) (c) (y+1l)

(d) (y-1l) (y+1l) (e) (y+1l) (y + 1l)

(16) Simplify $8x^2y \left(\frac{3xy}{6xy^2} \right)$

(a) x^2y (b) $4x$ (c) $4x^2$ (d) $4x^2y$ (e) $4xy^2$

(17) Solve for n in the equation $5 – 4n = 8$

(a) -3 (b) -¾ (c) 4 (d) $\frac{4}{3}$ (e) $\frac{-4}{3}$

(18) Find the number when divided by $\frac{2}{3}$ gives 27

(a) 16 (b) 15 (c) 26 (d) 18 (e) 32

(19) Factorize $cx – dx + dq – cq$

(a) (-c – d) (x – q) (b) (c – d) (x + q) (c) (c + d) (x + q)
(d) (d – x) (d + x) (e) (c – d) (x – q)

(20) What is the coefficient of q in the expansion of (2q + 1) (1 -2q)?
(a) 0 (b) -1 (c) -2 (d) 1 (e) 2

(21) When a number is added to another four times as big, the result is 30. What is the original number?
(a) 12 (b) 24 (c) 18 (d) 34 (e) 6

(22) Which of the followings is not a factor of $4qr^2$
(a) 2q (b) 2r (c) $3r^2$ (d) $4r^2$ (e) qr

(23) Remove the bracket and simplify 3x – 2(2x – y)
(a) x + 2y (b) 2y – x (c) x – 2y (d) x – y (e) 2x – y

(24) Solve the equation 2(a + 5) = 18
(a) 4 (b) 8 (c) 5 (d) 9 (e) 7

Use the following table to answer questions 25 and 26

X	-3	-2	-1	0	1	2	3	4	5
Y	a	b	c	d	e	f	g	h	i

(25) Find the value of c + g
(a) 4 (b) 2 (c) -2 (d) 3 (3) -1

(26) Evaluate $\frac{(a+d)c}{f}$

(a) $\frac{2}{3}$ (b) 0 (c) $\frac{-2}{3}$ (d) $\frac{1}{3}$ (e) $\frac{-3}{2}$

(27) The total age of a boy and his sister is 27 years. If the boy is 5 years older than his sister. How old is the sister?
(a) 5 years (b) 27 years (c) 22 years (d) 16 years
(e) 11 years.

(28) Expand the expression 2a(4a – c)
(a) $6a^2$ - c (b) 6a - 2ac (c) 8a - 2ac (d) $8a^2$ – 2ac
(e) 8a - c

(29) Solve the equation: 5a + 5 = 2a + 20
(a) 5 (b) 2 (c) 20 (d) 17 (e) 6

(30) a - ay can be factorised as……………………

(a) $y(a - 1)$ (b) $a(1 - 2y)$ (c) $a(1 - y)$ (d) $(a - y)$ (e) $(1 – y)$

(31) All are factors of 6a except (a) 6a (b) 2a (c) 4 (d) 3 (e) 6

(32) What is the perimeter of a square of side ycm?
(a) ym (b) 2ycm (c) 3ycm (d) 4ycm (e) 5ycm

(33) Yusuf has some trading cards. John has 3 times as many trading cards as Yusuf. They have 36 trading cards in all. Which of these equations represent their trading cards collection? (a) $x + 37 = 36$ (b) $3x = 36$ (c) $x + 3 = 36$ (d) $3x + 36 = x$ (e) $x + 36 = 3x$

(34) Simplify $3(x + y)$: (a) $3xy$ (c) $x + 3y$ (d) $x + y$ (e) $3x + 3y$

(35) What is $3x + 3x =$ (a) $6x^2$ (b) $6x$ (c) $9x^2$ (d) $9x$ (e) 6

(36) Solve for y if $5 + 3y = 11$ (a) 2 (b) 5 (c) 3 (d) 11 (e) 6

(37) The sum of four times a certain number and 29 is 85. What is this number?
(a) 2a (b) 85 (c) 14 (d) 4 (e) 56.

(38) Solve the equation $2y – 1 = 5y – 6$
(a) 2 (b) 2/5 (c) 1/5 (d) 1/6 (e) 5/3

(39) Expand the bracket and simplify $(a + b)^2$ (a) $a^2 + b^2$
(b) $a^2 + 2ab + b^2$ (c) $2a + 2b$ (d) $a^2 + ab + b^2$ (e) $a^2 + b^2 + 4$

(40) Tom is exactly two years older than Jane. Let T stands for Tom's age and J stands for Jane's age. Write an equation to compare Tom's age to Jane's age.
(a) $T = J$ (b) $T + J = 0$ (c) $J = T + 2$
(d) $T = J + 2$ (e) $T + J = 2$

Marking Scheme: 80 marks (2 marks per Question)

1.	e	21.	e
2.	b	22.	c
3.	e	23.	b
4.	a	24.	a
5.	c	25.	c
6.	a	26.	e
7.	d	27.	e
8.	b	28.	d
9.	d	29.	a
10.	b	30.	c
11.	a	31.	c
12.	c	32.	d
13.	b	33.	a
14.	e	34.	e
15.	d	35.	b
16.,	c	36.	a
17.	b	37.	c
18.	d	38.	e
19.	c	39.	b
20.	a	40.	d

Appendix B

Algebra Performance Test B (APTB) – Post-Test

Instructions: Attempt all the questions. Each question is followed by five options, Solve and choose the correct option for each question.

Time Allowed: 1 ½ hours **Gender: Male [ ] Female [ ]**

Name of your School:____

(1) Simplify 3x(4a – 5b) – 5x (3a – 3b)
(a) 3ax – 5b (b) (3a – 5b) (c) 5b – 3a) (d) -(3a+5b)x (e) (3a + 5b)x

(2) Solve the equation 2x + 5 = 19
(a) 7 (b) 8 (c) 5 (d) 9 (e) 23

(3) The following are factors of 6a except:
(a) 6a (b) 2a (c) 4 (d) 3 (e) 6

(4) Expand the expression (a + 2b) (a + b)
(a) $a^2 + 2b^2 + ab$ (b) $2ab^2 + b^2 + a^2$ (c) $a^2 + b^2 + ab$
(d) $2ab + b^2 + a^2$ (e) $a^2 + 3ab + 2b^2$

(5) The sum of three consecutive natural numbers is 72. Find the three numbers.
(a) 20, 21, 31 (b) 19, 20, 33 (c) 24, 24, 24 (d) 21, 25, 26 (e) 23,24,25

(6) Factorise the expression: 12cm – 16dm.
(a) 4m(3x – 4d) (b) 4m(4d – 3c) (c) 4d(4m – 3c) (d) 4m(3c + 4)
(e) 4d(3c - 4)

(7) Solve for x in the equation. 5 – 2x = 21

(a) 5 (b) -8 (c) 21 (d) 7 (e) 8

(8) Express $\frac{2x}{3}$ - $\frac{(X-1)}{4}$ as a single fraction

(a) $\frac{2x}{3}$ (b) $\frac{5x-3}{12}$ (c) $\frac{5x+3}{dx}$ (d) $\frac{11x+3}{12}$ (e) $\frac{12}{5x+13}$

(9) The sum of twice a certain number and 26 is 72. Find the number
(a) 26 (b) 72 (c) 46 (d) 23 (e) 98

(10) Expand $(1 – 2x)^2$
(a) $4x^2 - 4x + 1$ (b) $1 – 4x - 4x^2$ (c) $1 + 4x - 4x^2$
(d) $1 + 4x + 4x^2$ (e) $4x^2 - 4x - 1$

(11) Simplify the expression 3(2x – 3y) -2(3x – y)
(a) 6x – y (b) 7y (c) - 2y (d) -7y (e) 6x + y

(12) Solve the equation 2x – 1 = 5x – 6
(a) $\frac{3}{7}$ (b) $\frac{2}{3}$ (c) $\frac{5}{3}$ (d) $\frac{3}{5}$ (e) $\frac{7}{3}$

(13) Factorise 12c + 6d
(a) 6(d – 2c) (b) 6(x + 2d) (c) 6(2c + d) (d) 6(2c – d)
(e) 6(3c + d)

(14) Solve the equation -5(a – 2) = 15
(a) 1 (b) -1 (c) -2 (d) -5 (e) 2

(15) $\frac{1}{3}$of a number is added to $\frac{1}{5}$of the same number, the result is 8. Find the number. (a) 3 (b) 5 (c) 8 (d) (e) 10

(16) Which of the followings is a common factor of ab and bc.
(a) b (b) a (c) c (d) d (e) e

(17) What is the perimeter of a square of side xcm?
(a) xcm (b) 2xcm (c) 3xcm (d) 4xcm (e) 5xcm

(18) The difference between five times a number and twelve is 48. Find the number. (a) 5 (b) 48 (c) 12 (d) 60 (e) 17

(19) Solve the equation $\frac{2x}{3} - 4 = 0$

(a) 2 (b) 3 (c) 4 (d) -4 (e) 6

(20) Simplify 10 – 5(a – 2)
(a) -5(a – 2) (b) 10 - 5a (c) -5a-20 (d) 20 – 5a (e) 17a – 2

(21) Factorise $y^2 – 4y + 3$
(a) (y – 1) (y – 4) (b) (y + 1) (y + 3) (c) (y + 1) (y – 4)
(d) (y – 1) (y + 3) (e) (y – 1) (y – 3)

(22) Expand (3x – 2) (x – 4)
(a) $3x^2 – 14x + 8$ (b) $3x^2 – 14x – 8$ (c) $3x^2 + 14x + 8$
(d) $-3x^2 - 14x + 8$ (e) $-3x^2 - 14x – 8$

(23) The sum of three consecutive whole numbers is 27. Find the numbers.
(a) 7,8,9 (b) 6,7,8 (c) 8,9,10 (d) 7,8,9 (e) 9,10,11

(24) Simplify $(3m^2n)(4m^3n^2)$
(a) $(12m^2n^3)$ (b) $12m^5$ n^3 (c) $12mn^5$ (d) $12m^3n^5$ (e) $12m^3n^3$

(25) Find a number when divided by $\frac{3}{2}$ gives 12.
(a) 6 (b) 18 (c) 12 (d) 24 (e) 36

(26) A certain number divided by 3 and 3 added to its result.
The final answer is 8. What is the number?
(a) 3 (b) 8 (c) 6 (d) 15 (e) 14

(27) Solve for y: 5-2y = 20.
(a) 5 (b) 15 (c) $\frac{-15}{2}$ (d) $\frac{2}{15}$ (e) $\frac{13}{2}$

(28) Factorise ab – db + dy – ay
(a) (b – y)(a + d) (b) (b + y)(a – d) (c) (b + y)(a + d)
(d) (-b-y)(a-d) (e) (a-d)(b-y)

Use the following table to answer questions 29 and 30
y = -x

X	-3	-2	-1	0	1	2	3	4	5
Y	a	B	c	d	e	F	g	h	i

(29) Find the value of 2(a + e)
(a) 3 (b) 4 (c) 2 (d) 8 (e) 6

(30) Evaluate $\frac{b + d}{f + g}$
(a) $\frac{2}{5}$ (b) $\frac{5}{2}$ (c) $\frac{-5}{2}$ (d) $\frac{-2}{5}$ (e) $\frac{2}{5}$

(31) Simplify 3(x + y)
(a) 3xy (b) 3x + y (c) 3x + 3y (d) x + 3y (e) x + y

(32) What is 5y + 5y =
(a) 10y (b) 25y (c) $25y^2$ (d) $10y^2$ (e) y^2

(33) Abdullahi has some trading cards. Joseph has four times as many trading cards as Abdullahi. They have 40 trading cards in all. Which of these equations represent their trading cards collection? (a) x + 4 = 40

(b) $x + 40 = 40$ (c) $4x = 40$ (d) $x + 4x = 40$ (e) $x + 40 = 4x$

(34) Solve for y if $5 + 3y = 11$ (a) 11 (b) 2 (c) 3 (d) 11 9e) 16

(35) The sum of four times a certain number and 29 is 85. What is the number?
(a) 2a (b) 85 (c) 4 (d) 56 (e) 14

(36) Expand the bracket and simplify $(a + b)^2$
(a) $a^2 + 2ab + b^2$ (b) $a^2 + b^2$ (c) $a^2 + b^2 + 4$ (d) $2a + 2b$ (e) a^2b^2

(37) Joshua is exactly three years older than Ali. Let J stands for Joshua's age and A for Ali's age. Write an equation to compare Joshua's age and Ali's age. (a) J + A = O
(b) J = A + 3 (c) J + A = 3 (d) J = 3A (e) A = J + 3

(38) Solve for y if $\frac{3y}{2} - 8 = 10$
(a) 3 (b) 2 (c) 18 (d) 10 (e) 12

(39) Factorize $a^2 - 121$ -
(a) (a–121) (b) (a-11) (c) (a+11 (d) (a–11)(a+11)
(e) (a+11)(a+11)

(40) Which of the following is a common factor of 2ay and 7az?
(a) y (b) 2 (c) a (d) 7 (e) yz

Marking Scheme: 80 marks (2 marks per Question)

1.	d	21.	e
2.	a	22.	a
3.	c	23.	c
4.	e	24.	b
5.	e	25.	b
6.	a	26.	d
7.	b	27.	c
8.	c	28.	e
9.	d	29.	b
10.	a	30.	d
11.	d	31.	c
12.	c	32.	a
13.	c	33.	d
14.	b	34.	b
15.	d	35.	e
16.	a	36.	a
17.	d	37.	b
18.	c	38.	e
19.	e	39.	d
20.	d	40.	c

Appendix C

Algebra Retention Test (ART)

Instructions: Attempt all the questions. Each question is followed by five options, Solve and choose the correct option for each question.

Time Allowed: 1½ hours **Gender: Male [ ] Female [ ]**

Name of your School:____

(1) Expand the expression (x + 2y)(x + y)
(a) $x^2 + 2y^2 + xy$ (b) $2xy^2 + y^2 + x^2$ (c) $x^2 + y^2 + xy$
(d) $2xy + xy^2 + x^2$ (e) $x^2 + 3xy + 2y^2$

(2) Solve the equation 2a - 5 = 7
(a) 2 (b) 5 (c) 6 (d) 7 (e) 14

(3) b - by can be factorised as…………………..
(a) y(b – 1) (b) b(1 – 2y) (c) b(1 – y) (d) (b – y) (e) (1 – y)

(4) A number is multiplied by 6 and 4 is added. The result is 34. Find the number?
(a) 4 (b) 5 (c) 6 (d) 7 (e) 10

(5) Simplify $\frac{1}{p} + \frac{1}{q}$

(a) $\frac{p+q}{pq}$ (b) $\frac{p-q}{pq}$ (c) $\frac{p+q}{pq}$ (d) $\frac{-p-q}{pq}$(e) $\frac{pq}{p+q}$

(6) Solve the equation 2y – l = 5y – 6
(a) $\frac{3}{7}$ (b) $\frac{2}{3}$ (c) $\frac{5}{3}$ (d) $\frac{3}{5}$ (e) $\frac{7}{3}$

(7) Simplify the expression 3(2y - 3x) -2(3y – x)
(a) 6y – x (b) 7x (c) -2x (d) -7x (e) 6y + x

(8) Find a number when divided by 2/3 gives 12.
(a) 2 (b) 3 (c) 12 (d) 8 (e) 17

(9) Expand $(2x – 1)^2$
(a) $4x^2 - 4x + 1$ (b) $4x^2 – 4x - 1$ (c) $4x^2 + 4x + 1$
(d) $4x^2 + 4x – 1$ (e) $-4x^2 - 4x - 1$

(10) Find the coefficient of a in (2 – a)(3 + a)
(a) 1 (b) 3 (c) 2 (d) -1 (e) -3

(11) The total age of a boy and his sister is 27 years. If the boy is 5 years older than his sister. How old is the boy?
(a) 5 years (b) 27 years (c) 16 years (d) 11 years (e) 22 years

(12) Expand (a – b)(b – a)
(a) $-2ab + a^2 - b^2$ (b) $2ab + a^2 + b^2$ (c) $2ab - a^2 + b^2$
(d) $2ab + a^2 - b^2$ (e) $-a^2 - b^2 + 2ab$

(13) Which of the followings is not a factor of qr^2
(a) q (b) r (c) rq (d) r^2 (e) p

(14) Solve for y in the equation 5 - 4y = 8
(a) -3 (b) -¾ (c) 4 (d) $\frac{4}{3}$ (e) $\frac{-4}{3}$

(15) Divide $8x^2y$ by $6xy^2$
(a) $\frac{4y}{3x}$ (b) $\frac{4x}{3}$ (c) $\frac{3y}{4x}$ (d) $\frac{4x}{3y}$ (e) $\frac{3x}{4y}$

(16) The length of a side of a square is ycm. Find the perimeter. (a) 6ycm (b) 3ycm (c) 4ycm (e) 8ycm (e) 16 ycm

(17) The sum of three consecutive whole numbers is 27. Find the numbers.
(a) 7.8,9 (b) 8,9,10 (c) 6,7,8 (d) 7,8,9 (e) 9,10,11

(18) Factorise $y^2 - (121)$
(a) (y – 121) (b) (y – 11) (c) (y + 11)

(d) (y – 11)(y + 11 (e) y + 11)(y + 11)

(19) Solve the equation $\frac{5x - 3}{2}$ = ½

(a) $\frac{5}{2}$ (b) $\frac{-3}{2}$ (c) $\frac{1}{2}$ (d) $\frac{5}{3}$ (e) $\frac{4}{5}$

(20) Expand $(a - b)^2$
(a) $a^2 - 2ab + b^2$ (b) $a^2 - 2ab - b^2$ (c) $a^2 + 2ab + b^2$
(d) $a^2 + 2ab - b^2$ (e) $2ab - a^2 - b^2$

(21) Simplify $17y^2 - 3y + 3 - 2(7y^2 - 4y + 1)$
(a) $3y^2 - 5y + 1$ (b) $3y^2 - 5y - 1$ (c) $3y^2 + 5y + 1$
(d) $3y^2 + 5y - 1$ (e) $-3y^2 - 5y - 1$

(22) $\frac{1}{5}$ of a number is added to $\frac{1}{3}$ of the same number, the result is 8. Find the number?

(a) 3 (b) 5 (c) 8 (d) 15 (e) 10

(23) Which of the followings is a common factor of xy and yz?
(a) x (b) y (c) z (d) w (e) v

(24) Solve the equation -5(a – 2) = 15
(a) -1 (b) 1 (c) -2 (d) -5 (e) 2

(25) Expand $(-a - 2)^2$
(a) $a^2 - 4a - 4$ (b) $a^2 - 4a + 4$ (c) $-a^2 - 4a - 4$
(d) $a^2 + 4a - 4$ (e) $a^2 + 4a + 4$

(26) The sum of twice a certain number and 26 is 72. Find the number.
(a) 26 (b) 72 (c) 23 (d) 46 (e) 98.

(27) Solve the equation y + 7 = 19 + 2y
(a) 12 (b) 28 (c) 26 (d) -12 (e) -26

(28) If a = 1, b = 2, c = -1 and d = 3, answer questions 28 and 29.
$\frac{\boldsymbol{a}}{\boldsymbol{b}} + \frac{c}{d}$ (a) 6 (b) $\frac{1}{6}$ (c) -6 (d) $\frac{-1}{6}$ (e) 3

(29) $\frac{\boldsymbol{ac}}{\boldsymbol{b\,d}}$ (a) $\frac{-1}{6}$ (b) 6 (c) 5 (d) 2 (e) 3

30. Simplify 3x - (x - 5)
(a) 2x – 5 (b) 2x + 5 (c) -2 (d) -2x – 5 (e) 5 - 2x

(31) Which of the following is not a factor of 6a?
(a) 6a (b) 2a (c) 4 (d) 3 (e) 6

(32) Simplify 4(a + b)
(a) 4a (b) 4b (c) 4a + b (d) a + 4b) (e) 4a + 4b

(33) Job has some trading cards. Ayuba has five times as many trading cards as Job. They have 50 trading cards in all. Which of the following equations represent their trading cards collection? (a) y = 5y + 50
(b) 5y = y+50 (c) y + 5 = 50 (d) y + 5y = 50 (e) y + 3 = 50

(34) What is a + a = ? (a) a^2 (b) 2a (c) 2 (d) 0 (e) a

(35) Solve for x if 3y + 5 = 11 (a) 2 (b) 3 (c) 5 (d) 11 (e) 6

(36) The sum of four times a certain number and 29 is 85. Find the number.
(a) 29 (b) 14 (c) 85 (d) 56 (e) 114

(37) Expand the bracket and simplify $(a + b)^2$
(a) $a^2 + b^2$ (b) $2a + 2b$ (c) $a^2 + 2ab + b^2$ (d) $a^2 + b^2 + 4$ (e) $(a + b)$

(38) Yahaya is exactly five years older than Maryam. Let Y stands for Yahaya's age and M stands for Maryam's age. Write an equation to compare Yahaya's age and Maryam's age. (a) $Y = M + 5$ (b) $Y = M$
(c) $M = Y + 5$ (d) $Y + M = 5$ (e) $Y + M = 0$

(39) Factorise $x^2 – 4x + 3$: (a) $(x – 1)(x – 4)$ (b) $(x + 1)(x + 3)$
(c) $(x + 1) (x – 4)$ (d) $(x+ 1)(x – 3)$ (e) $(x – 1)(x – 3)$

(40) Solve the equation $\frac{3y}{2} - 8 = 10$
(a) 3 (b) 2 (c) 8 (d) 12 (e) 10

Marking Scheme: 80 marks (2 marks per Question)

1.	e	21.	c
2.	c	22.	d
3.	c	23.	b
4.	b	24.	a
5.	a.	25.	e
6.	c	26.	c
7.	d	27.	d
8.	d	28.	b
9.	a	29.	A
10.	d	30.	B
11.	c	31.	C
12.	e	32.	E
13.	e	33.	d
14.	b	34.	b
15.	d	35.	a
16.	c	36.	b
17.	b	37.	c
18.	d	38.	a
19.	e	39.	e
20.	a	40.	d

Appendix D

Algebraic Attitude Questionnaire Scale (AAQS)

Date: …………………………

Dear Student,

The purpose of this questionnaire is to find out students' attitude towards learning of algebra as a branch of mathematics.

Instructions:

(1) The information you give about your feelings towards learning algebra will be handled in confidence. Please answer the items below as honestly as possible.

(2) Put [✓] in the brackets of your answer.

SECTION A: Personal Background Information

(1) Name of your School ---
-

(2) Gender: Male [ ] Female [ ]

SECTION B: Your feelings about learning and performance in algebra

Instruction: This section, you are to decide honestly whether you strongly agree (SA), Agree (A), Disagree (D) or Strongly disagree (SD). Put a tick [✓] against each statement according to your sincere feelings.

STUDENT'S FEELINGS	SA	A	D	SD
I enjoy learning algebra.				
Algebra lessons are not interesting.				
Algebra is very useful in life.				
It is the teacher that can make algebra learning easier.				
Among branches of mathematics, algebra is my favourite.				
I am given a lot of unnecessary algebra assignments				
I have enough algebra textbooks and other learning materials.				
I fear algebra when mathematics examination is mentioned.				
I do a lot of algebra exercise on my own or with a friend.				
To learn algebra is to remember what the teacher says and does when in class.				
The best way to learn algebra is to discover a concept by oneself				
My marks are always low in algebra.				
My parents encourage me to learn algebra and perform well in it.				
I like my mathematics teacher that teaches algebra.				
I want to develop my algebra skills.				
Algebra helps develop the mind and teaches a person thinks.				
I can think of many ways that I use algebra outside of school				
I have a lot of self confidence when it comes to algebra.				
Based on interest in algebra, I am confident to learn advanced mathematics.				
Algebra should not be part of mathematics				

Source: Adapted Owusu (2015)

Appendix E

Reliability Coefficients For Algebra Performance Test (APT)

For test-retest, Pearson Product Moment Correlation coefficient is used as follows:

$$r = \frac{N\sum AB - (\sum A)(\sum B)}{\sqrt{[N\sum A^2 - (\sum A)^2][N\sum B^2 - (\sum B)^2)]}}$$

$$= \frac{40(392) - (122)(117)}{\sqrt{[40(422) - (122)^2][40(381) - 117^2]}}$$

$$= \frac{15680 - 14274}{\sqrt{(16880 - 14884)(15240 - 13689)}}$$

$$= \frac{1406}{\sqrt{(1996)(1551)}} = \frac{1406}{\sqrt{3095796}}$$

$$= \frac{1406}{1759.4874} \quad 0.7991 = \quad 0.80$$

Reliability Coefficients For Algebraic Attitude Scale (AAS)

For Split Halves Method, Spearman Rank Correlation Coefficient is used as follows:

$$P = 1 - \frac{6\sum D2}{N(N^2 - 1)}$$

$$= 1 - \frac{6 \times 654}{40(1599)}$$

$$= 1 - \frac{3324}{63960}$$

$$= 1 - 0.05 = 0.95$$

Spearman Brown Prophecy Correction:

$$Pxx^{11} = \frac{2Pxx^{1}}{1 + Pxx^{1}}$$

$$= \frac{2(0.95)}{1.95}$$

$$= \frac{1.9}{1.95}$$

$$= 0.97$$

Appendix F

Experimental Group Lesson Plan

Lesson 1

Subject: Mathematics

Class: JSS III

Average Age: 14 years

Duration: 40 minutes

Gender: Mixed

Topic: **Simplification of Algebraic Expressions**

Instructional Materials:

Charts, pencils, ruler, oranges, banana, palm dates.

Behavioural Objective:

By the end of the lesson, the students should be able tosimplify any given algebraic expressions.

Previous Knowledge:

The students are familiar with algebraic expressions.

Introduction: The teacher introduces the lesson based on the students' previous knowledge.

The teacher should engage the learners as follows:	
Teacher's Activity	**Learners are expected to write as follows:**
The sum of a number and 2. A number that is 5 more than y.	x + 2 (Any alphabet can be used) y + 5
The difference between a number and 2	a – 2 (Any alphabet can be used.)
The product of 3 and a number	3b (Any alphabet can be used)
A number that is half the sum of 2 and 3	$c = \frac{(2+3)}{2}$ (Any letter can be used).
x divided by 2	$\frac{X}{2}$
A number that is decreased by 9.	d – 9. Any letter can be used.

Presentation: The teacher presents the lesson in steps as follows:

Step I: The teacher leads the students to exploration

The teacher directs the students to make similar, but different statements like he did under introduction and symbolize among themselves. The teacher guides and corrects them

Step II: This is explanation stage.

The teacher divides the students into groups. Each group with five students. Each group has its learning materials. Oranges, banana and palm dates brought to the class are distributed in the four groups according to their needs. Now the teacher writes and asks the four groups to simplify: 6 palm dates + 2 oranges – 2 palm dates +7 bananas + 3 oranges – 3 bananas. With joint work in each group, they should get the answer as 4 palm dates + 5 oranges + 4 bananas. The teacher tells the students that in algebra we have different fruits and have names like x^4, x^2 and just plain numbers. The teacher asks the students to simply $6x^2 + 2x^4 - 2x^2 + 7 + 3x^4 - 3$. In a similar way they should be able to get answer as $4x^2 + 5x^4 + 4$.

Step III: This is elaboration stage.

The teacher gives two new questions for the students to solve on group basis. The teacher guides and corrects them

(1) Remove bracket and simplify: $3a - 2(2a - b)$

(2) Evaluate $\frac{2x-3b}{b+x}$ if x = 2 and b = 1

Evaluation: Individual student solves three questions given by the teacher

(1) Simplify the expression 2(3x + 2) – 3(x + 3)

(2) Simplify 2xy(3xy)

$6y^2$

(3) Simplify 3y(4x – 5b) – 5y(3a – 3b)

LESSON 2

Subject: Mathematics

Class: JSS III

Average Age: 14 years

Duration: 40 minutes

Gender: Mixed

Topic: Expansion of Algebraic Expressions

Instructional Materials: Cardboard with algebraic tiles, pencil, ruler and worksheets.

Behavioural Objectives:

By the end of the lesson, the students should be able to expand any given algebraic expressions. They should be able to use real life problems as vehicles to motivate the use of algebra and algebraic thinking.

Previous Knowledge:

The students have been taught simplification of algebraic expressions.

Introduction: The teacher engages the students based on the previous knowledge.

The teacher asks the students to simplify the following expressions: (1) $10 – 5(a – 2)$ and

(2) $3x(4a-5b) – 5x(3a – 2b)$

Expected correct answers are: (1) $20 – 5a$ (2) $-(3a + 5b)x$

Presentation: The teacher presents the lesson on steps basis as follows:

Step I: The teacher guides the students on exploration.

The teacher divides the students into groups with five in a group. The teacher poses the following problem to the students. Yusuf and John bought a new house that is square shaped. They like the shape but would like to extend it. They decided to increase the length by 3m and the width by 3m.

(i) Write an expression for the area of the existing house

(ii) Write an expression for the area of the new house.

(iii) Simplify the expression.

Among the expected students' responses are:

(a) There are no measurements

(b) How do we get the area?

(c) How can we get the area when we don't have any numbers? (d) How do I show the extension? Now, the drawn algebra tiles on Cardboard paper for this problem are spread for the four groups to study. Eventually, they would come out with

$(x + 3)(x + 3) = (x + 3)^2 = x^2 + 6x + 9$. [See Appendix J(a)]

Step II: This is explanation stage.

Rotating the tiles can enable students to move flexibly in different directions. The teacher asks the students to use their worksheets, pencil, ruler to draw algebra tiles to simplify $(2 + x)(3 + x)$.

Always emphasize to students that they must form a rectangle/square. The teacher supervises and guides the four groups to get the correct answer as : $(2 + x)(3 + x) = x^2 + 5x + 6$

Step III: This is elaboration stage.

The teacher gives one question for the students to solve on group basis. The teacher supervises and corrects them. Expand $(3x + 2)^2$

Evaluation:

The teacher gives two questions for the individual students to solve as homework. Expand:

(1) $(2x - 1)^2$

(2) $2x(4x - b)$

Lesson 3

Subject: Mathematics

Class: JSS III

Average Age: 14 years

Duration: 40 minutes

Gender: Mixed

Topic: Factors and Factorization of Algebraic Expressions.

Instructional Materials:

Pencils, ruler, worksheets, and drawn algebraic tiles on cardboard paper.

Bahavioural Objectives:

After learning the lesson, students should be able to:

(1) determine the factors of algebraic forms.

(2) determine the algebraic form into its factors.

Previous Knowledge:

The students have been taught expansion of algebraic expressions.

Introduction: Based on the students' prior knowledge, the following problem is posed: Suppose a rectangle has the length of (x + 3) and the width of (x + 1), Find (x + 1) (x + 3). The students should be able to have the correct answer as $x^2 + 4x + 3$

The teacher now tells the students that (x + 1)(x + 3) are factors of $x^2 + 4x + 3$.

Presentation: The teacher presents the lesson on steps basis as follows:

Step I: The teacher guides the students on exploration.

The teacher divides the class into groups with five students in each group. Cardboard paper with algebra tiles to factorize $x^2 + 3x + 2$ is distributed to the four groups. They are to study all the diagrams on the cardboard paper. The teacher goes round the groups in case they need any assistance. Eventually they observe that the factors of $x^2 + 3x + 2$ are (x + 2 and (x + 1). [See Appendix J(b)]

Step II: This is explanation stage.

Suppose we are to factorize $ax^2 + bx + c$ when $a \neq 1$ e.g.

$3x^2 – 7x – 6$. The teacher asks the students to list factors of 3. They should come with [1] and [3], [-1] and [-3]. The students should list factors of –6 as follows: (1) and (-6); (-1) and (6); (-2) and (3); (2) and (-3). Place the factors of 3 inside the box [ ] and the factors of -6 inside the circle O in the following expression (x + O)(x + O). Find themultiplication of two binomials. Its middle term, which is the sum of outer and inner is equal to -7x

(x + 1)(3x + -6)	→ -6x + 3x	=	-3x
(x + -6)(3x + 1)	→ x - 18x	=	-17x
(x + -1)(3x + 6)	→ 6x – 3x	=	3x
(x + 6)(3x + -1)	→ -x + 18x	=	17x
(x + 2)(3x + -3)	→ -3x + 6x	=	3x
(x + -3)(3x + 2)	→ 2x -9x	=	-7x

Thus, $3x^2 - 7x - 6 = (x - 3)(3x + 2)$

Step III: This is elaboration stage.

One quadratic expression is given to the students to factorise on group basis.

(1) Factorize $a^2 - 4a + 3$

Evaluation: Students and teacher can discuss any observations in the day's lesson. The teacher gives two questions on factorization as individual student homework.

Factorize: (1) $ax = dx + dq - aq$

(3) $c^2 - 121$

Lesson 4

Subject: Mathematics

Class: JSS III

Average Age: 14 years

Duration: 40 minutes

Gender: Mixed

Topic: Simple Equations in one variable

Instructional Materials:

Pencils, ruler, worksheets, cardboard paper with eight different Linear equations written on it.

Behavioural Objective:

By the end of the lesson, students should be able to solve linear equations in one variable with rational number coefficients

Previous Knowledge:

The students have been taught factors and factorization of algebraic expressions.

Introduction:

Based on the students' entry behaviour, the following questions are posed to them to solve. (a) Simplify $3(2x - 3y) - 2(3x - y)$.

(b) Factorise $cx - dx + dq - cq$. The expected correct answers from the students are: (a) $-7y$ (b) $(c-d)(x - q)$.

Presentation:

The teacher presents the lesson steps basis as follows:

Step I: The teacher guides the students on exploration.

The students are divided into groups with five students in each group. The eight linear equations written on cardboard paper are given to them to classify under the headings. Always true, sometimes true, never true. The teacher goes round to guide the students. Eventually the correct responses are:

Always True	Sometimes True	Never True
3 + x = x +3	2–x = x–2 when x = 2	x + 5 = x - 3
7x-14 = 7(x – 2)	6x = x when x = 0	
	4x = 4 when x = 1	5x – 5 = 5(x + I)
	$\frac{10}{2x}$ = 5 when x = 1	

Step II: This is explanation stage.

The teacher gives two questions on linear equations for the students to solve on group basis. The teacher goes round to guide the students

if necessary. (1) 5 - x = 6 (2) 4x + 1 = 3.

The correct answers are: (1) -1 (2) ½

This is elaboration stage.

Step III: Two more involving questions are given to the students to solve on group basis:

(1) y – 7 = 19 + 2y (2) 2(2m – 5) = m + 8

Correct answers (1) -26 (2) 6

Evaluation:

Teacher to organize a whole – class discussion about what has been learned and explore the different methods of justification used when categorizing equations. Try to include a discussion of at least one equation from each column. The teacher can now give three questions on linear equations as home work.

(1) Solve for x in the equation $5 - 4x = 8$

(2) Solve the equation $m + 7 = 19 + 2m$

(3) Find the value of y if $3y – 8 = 10$

Lesson 5

Subject: Mathematics

Class: JSS III

Average Age: 14 years

Duration: 80 minutes (Double lesson)

Gender: Mixed

Topic: Word Problems Involving Linear Equations.

Instructional Materials: Pencil, ruler, worksheets, two students, two textbooks.

Behavioural Objectives:

By the end of the lesson, the students should be able to translate word problems to linear equations and solve accordingly. The students would also be able to see how linear equations can be used in real life situations.

Previous Knowledge:

The students have been taught how to solve linear equations.

Introduction:

The teacher should engage the students with the following problems. (1) Solve the equations: (a) $5 - 4n = 8$ (b) $3a - 8 = 10a$. (2) Symbolize the statement; A number increased by 5. The expected correct responses are: (1) a) -¾ b) -8/7 (2) y + 5

Presentation:

The teacher presents the lesson in steps as follows:

Step I: The teacher leads the students to exploration.

The teacher forms groups with five students in each group. The teacher selects two students from two groups. Suppose the sum of the ages of the two students is 25 years. If one is three years older than the other, find the ages of the two students. They should use their worksheets to solve on group basis. The teacher goes round to assist the students where necessary. After the struggle, the correct answer should be 11 years and 14 years. The teacher holds two textbooks. Suppose the two textbooks cost ₦1,000. If one is ₦300 more than the other, find the cost of each textbook. The teacher goes round to check the students' work. Eventually the correct answer is ₦350 and ₦650.

Step II: This is explanation stage.

The teacher gives guidelines to the students. List all the unknowns in the problem and assign a variable to each. Translate the problem into a system of equation using key terms to describe the mathematical operation terms, like 'increased by' 'total of', 'more than', 'combined together', 'sum', 'added to' etc. Involve addition. Terms like 'decreased by', 'difference between' , 'less than', 'fewer than', 'reduced by', 'difference of', etc. involve subtraction. Phrases like 'of', 'product of', 'times', 'multiplied' etc, require multiplication. Terms like 'per', 'out of', 'ratio of'; 'quotient of', percent' require division. When words like 'is' or 'will be' feature, this indicates the total amount of the unknown expressions must be equal.

Step III: This is elaboration stage.

The teacher gives two questions for the students to solve on group basis. (1) Find the number when divided by 2/3 gives 27 (2) Find two consecutive whole numbers such that five times the smaller number plus three times the greater number makes 59. The teacher goes round to check the progress of the four groups. The expected correct solutions are:(1) 18 (2) 7 and 8.

Evaluation:

Check the gotten solutions by fixing the answers into each equation. If both sides are equal, the solution is correct. If both sides are not equal, check your work and revise your solution to the problem. After this, the teacher gives three questions as homework for the students to solve.

(1) When a number is added to another four times as big, the result is 30. Find the original number.

(2) The sum of three consecutive natural numbers is 72. Find the three numbers.

(3) The sum of twice a certain number and 26 is 72. Find the number

Appendix G

Control Group Lesson Plan

Lesson 1

Subject: Mathematics

Class: JSS III

Average Age: 14 years

Duration: 40 mins.

Gender: Mixed

Topic: Simplification of Algebraic Expressions.

Instructional Materials:

Mathematics textbook for JSS Two.

Behavioural Objective:

By the end of the lesson the students should be able to simplify any given algebraic expressions.

Introduction: The teacher asks the following questions:

(i) What is algebra?

(ii) Write an algebraic expression?

Presentation: The teacher presents the lesson in steps as follows:

Step I: The teacher solves the following examples on the board for the students. Simplify the following algebraic expressions:

(1) $6x^2 + 2x^4 – 2x^2 + 7 + 3x^4 – 3$.

(2) $2(3a + 2) – 2(a + 3)$.

The teacher answers any likely questions from the students.

Step II: The teacher writes one question on the board from the students' mathematics textbook and ask a student to solve it.

Simplify: $10 - 5 (x - 2)$

Evaluation: The teacher writes one question on the board for the students to solve. He goesround, the class to check their work.

Simplify the expression $3(2y - 3x)-2(3y - x)$

Conclusion: The teacher writes three questions from the students' mathematics textbook as home work.

(1) Divide $8x^2y$ by $6xy^2$

(2) Simplify $\frac{1}{a} + \frac{1}{b}$

(4) Simplify: $3y(4a - 5b) - 5y(3a - 3b)$

Lesson 2

Subject: Mathematics

Class: JSS III

Average Age: 14 years

Duration: 40 minutes

Gender: Mixed

Topic: Expansion of Algebraic Expressions

Instructional Materials:

Mathematics textbook for JSS Two.

Behavioural Objectives:

By the end of the lesson, the students should be able to expand any given algebraic expressions. They should be able to use real life problems as vehicles to motivate the use of algebra and algebraic thinking

Previous Knowledge:

The students have been taught simplification of algebraic expressions.

Introduction: Based on the students' entry behaviour, the teacher asks any able students to simplify the following expressions:

(1) $10 - 5(a - 2)$

(2) $3x(4x - 5b) - 5x(3a - 2b)$

Presentation: The teacher presents the lesson on steps basis as follows:

Step I: The teacher solves the following two questions as examples on the board. Expand and simplify the expressions:

(i) $(x + 3)^2$ (ii) $(2x + x)(3 + x)$

In case the students have any question, the teacher gives appropriate response.

Step II: The teacher writes a question on the board for any capable student to solve it. Expand $(a – b)^2$

Evaluation: The teacher writes a question on the board for the students to solve. He goes round the class to check their work.

Expand: $(-a – 2)^2$

Conclusion: The teacher writes out three questions from the students' mathematics text book to solve as homework.

(1) Expand the expression $2b(4b – c)$

(2) Expand $(3x + 2)^2$

(3) Expand the expression $(2x + y)(x + y)$

Lesson 3

Subject: Mathematics

Class: JSS IIi

Average Age: 14 years

Duration: 40 mins.

Gender: Mixed

Topic: Factors and Factorization of Algebraic Expressions.

Instructional Materials:

Mathematics textbook for JSS Two.

Behavioural Objectives:

After learning the lesson, students should be able to:

(1) determine the factors of algebraic forms.

(2) determine the algebraic form into its factors

Previous Knowledge:

The students have been taught expansion of algebraic expressions.

Introduction: Based on the students' previous knowledge, the teacher asks them to expand and simplify the following expressions:

(1) $(x + 1)(x + 3)$

(2) $(x + 2)(x+ 1)$

Presentation: The teacher presents the lesson on steps basis as follows:

Step I: The teacher solves the following questions as examples on the board:

Factorize the following expressions:

(1) $x^2 + 3x + 2$

(2) $3x^2 - 7x - 6$

Step II: In case the students have any question, the teacher gives appropriate response. Afterwards , the teacher writes a question on the board for any capable student to solve.

Factorise $ax - dx + dq - aq$

Evaluation: The teacher writes a question on the board for the students to solve and he goes round the class to supervise them. Factorise: $x^2 - 121$.

Conclusion: From the students' mathematics textbook, the teacher writes out three questions as homework for the students.

(1) Factorise: $12x + 6y$

(2) Factorise the expression $12am - 16dm$

(3) Factorise:$a^2 - 4a + 3$

Lesson 4

Subject: Mathematics

Class: JSS III

Average Age: 14 years

Duration: 40 minutes

Gender: Mixed

Topic: Simple Equations in One Variable.

Instructional Materials:

Mathematics textbook for JSS Two.

Behavioural Objective:

By the end of the lesson, students should be able to solve linear equations in one variable with rational number coefficients.

Previous Knowledge:

The students have been taught how to simplify, expand and factorize any given algebraic expressions accordingly.

Introduction: The teacher asks students the following questions based on their previous knowledge:

(1) Simplify $3(2x - 3y)-2(3x - y)$

(2) Factorize: $cx - dx + dq - cq$

Presentation: The teacher presents the lesson on steps basis as follows:

Step I: The teacher gives the following two questions as examples.

Solve the following equations.

(1) $2x + 5 = 19$ (2) $5 - 2y = 21$

Step II: The teacher writes one question on the board for the students to solve. In case of any question from students, the teacher gives appropriate answer.

Solve for x if $5 + 3x = 11$

Evaluation: The teacher writes a question on the board for the students to solve and he goes round to supervise them.

Solve the equation: $2y - 1 = 5y - 6$

Conclusion: The teacher gives three questions as homework from the students' mathematics textbook. Solve the following equations:

(1) $2a + 5 = 19$

(2) $5(x + 2) = 15$

(3) $2y - 1 = 5y - 6$

Lesson 5

Subject: Mathematics

Class: JSS III

Average Age: 14 years

Duration: 80 minutes (Double Period)

Gender: Mixed

Topic: Word Problems Involving Linear Equations.

Instructional Materials:

Mathematics textbook for JSS Two.

Behavioural Objectives:

By the end of the lesson, the students should be able to translate word problems to linear equations and solve accordingly. The students would also be able to see how linear equations can be used in real life situations

Previous Knowledge:

The students have been taught how to solve simple equations in one variable.

Introduction: Based on the students' entry behaviour, the teacher asks the following questions.

Solve the equations: (1) $3a - 8 = 13$ (2) $5 - 4y = 8$.

Presentation: The teacher presents the lesson on steps basis as follows:

Step I: The teacher gives the following two questions as examples:

(1) Find the number when divided by 2/3 gives 27

(2) Find two consecutive whole numbers such that five times the smaller number plus three times the greater number makes 59.

Step II: The teacher answers any likely questions from the students. The teacher writes a question on the board to any capable student to solve it.

A number is multiplied by 6 and 4 is added. The result is 34. Find the number.

Conclusion: 1. The teacher writes out three questions from the students' mathematics textbook to solve as homework.

Yusuf is exactly two years older than Jane. Let Y stands for Yusuf's age and J stands for Jane's age. Write an equation to compare Yusuf's age and Jane's age.

2. The sum of four times a certain number and 29 is 85. Find the number.

3. The total age of a boy and his sister is 27 years. If the boy is 5 years older than his sister. How old is the sister?

Appendix H

Department of Science Education,
Ahmadu Bello University,Zaria.

Date: ……………………………..

Dear Research Assistants,

Thanks for cooperation to assist me in this research work. The topic of the research is "The Impact of Constructivist Teaching Strategy on the Attitude, Performance, and Retention of JSS Two Students in Algebra in Kogi State, Nigeria.

Kindly assist me to operate as follows:

There are four instruments for the research. They are Algebra Performance Test A, (APTA); Algebra Performance Test B (APTB), Algebra Retention Test (ART) and Algebraic Attitude Scale (AAS). An arm of JSS Two class is to be used in your school. The same groups of students are to be used throughout the research exercise.

There should be six weeks teaching for the topics: Simplification of algebraic expressions, Expansion of Algebraic Expressions, Factorization of Algebraic Expressions, Linear Equations in one variable and Word Problems in Linear Equations of one Variable. APTA and AAS are given to the students before commencement of teaching. At the end of the six weeks teaching, APTB and AAS are given to the students to answer. After two weeks, ART is given to the students to answer.

Thanks for your anticipated positive cooperation.

Yours faithfully,

J. S. MOMOH