

**EFFECTS OF PROBLEM SOLVING INSTRUCTIONAL METHOD ON
ATTITUDE AND PERFORMANCE IN ALGEBRA AMONG SENIOR
SECONDARY SCHOOL STUDENTS IN KADUNA STATE NIGERIA**

BY

**Safiya SHU'AIBU
(P14EDSC 8068)**

**A PROJECT SUBMITTED TO THE SCHOOL OF POSTGRADUATE
STUDIES, AHMADU BELLO UNIVERSITY, ZARIA IN PARTIAL
FULFILLMENT OF THE REQUIREMENT FOR THE AWARD OF
MASTERS DEGREE IN DEPARTMENT OF MATHEMATICS
EDUCATION STUDIES, AHMADU BELLO UNIVERSITY ZARIA
NIGERIA**

MARCH, 2018

**EFFECTS OF PROBLEM SOLVING INSTRUCTIONAL METHOD ON
ATTITUDE AND PERFORMANCE IN ALGEBRA AMONG SENIOR
SECONDARY SCHOOL STUDENTS IN KADUNA STATE NIGERIA**

BY

Safiya SHU' AIBU

MARCH, 2018

DECLARATION

I, Safiya SHU'AIBU (Med/EDUC/760/2009-2010; P14EDSC8068), declare that this Dissertation titled "Effect of Problem Solving Instructional Method on Attitude and Performance in Mathematics among Senior Secondary School Students in Kaduna State, Nigeria" is my personal research work. It has never been presented anywhere either wholly or partially for the purpose of the award of a higher degree. All the quotations are dully acknowledged by means of references in this work.

Safiya SHUA'IBU

Date

CERTIFICATION

This dissertation entitled “Effects of problem solving strategy on Attitude and Performance in Algebra among Senior Secondary School Students in Kaduna State Nigeria” written by Safiya SHU’AIBU M.ED/EDUC/7601/2009-2010 (P14EDSC 8068) meets the regulation governing the award of the degree of Masters in Mathematics Education, Ahmadu Bello University, Zaria and is approved for its contribution to knowledge and literary presentation.

Prof. Mamman Musa
Chairman Supervisory Committee

Date

Dr. Maruf O. Ibrahim
Member Supervisory Committee

Date

Prof. S. S. Bichi
Head, Science Education Department

Date

Prof. S. Z Abubakar
Dean, School of Postgraduate Studies

Date

DEDICATION

This work is dedicated to my husband, my parents, brothers and my lovely children.

ACKNOWLEDGEMENT

My profound gratitude is to Allah (SWT) for guiding and endowing me with the rightful knowledge, which make this study a reality. I expressed my sincere gratitude to Prof. M. Musa and Dr. M. O. Ibrahim my major and minor supervisors respectively, for guiding this work to a successful completion and also for assisting me with the necessary materials required for this study. I acknowledge with many thanks the enormous contributions made by Prof. Y. K. Kajuru, Prof. C. Bolaji, Prof. A. I. Usman and all members of staff of the Department of Science Education A. B. U. Zaria, specifically Mallam I. H. Usman for their guidance, support and assistance may Almighty Allah reward them, I appreciate the cooperation given me by the Principals of Government Secondary Schools. I also appreciate the support given to me by Mr. Ayuba. Didam the permanent Board Member one of the Federal Capital Territory Universal Basic Education Board Abuja for his moral support throughout the duration of the study. The endurance and support given to me throughout the period of the study by my family, Alhaji Umar Adamu my husband Adamu Umar, Muhammad Umar my sons is highly appreciated I thank the entire staff of Computer Department of FCT Universal Education Board Abuja. May Almighty Allah reward them abundantly. Finally, this acknowledgement would not be complete if the vital role played in my upbringing by my parents Alhaji Shu'aibu Umar and Hajiya Mariya Shu'aibu, may Allah (SWT) bless them with good health, long life and peace of mind to enjoy the fruit of their labour and may Aljannatul Firdausi be our abode.

ABSTRACT

This study basically assessed the effect of problem solving strategy on attitude and academic performance of students in algebraic concept of mathematics as well as the effect of school location on students' performance were established., A total of two hundred and thirty-eight (238) students out of a population of two thousand four hundred (2400) students were used for the study. The responses from the instrument used in the study formed the basis for data analysis. The study cited several literature and empirical studies. The quasi-experimental design was used for this study. Both descriptive and inferential statistics were used for the analyses of the data collected from the sampled students. The reliability of the two instruments AAT and ATQ were established with the use of the test-retest reliability estimate and the coefficients were found to be 0.87 and 0.89 respectively which signified that the instruments were highly reliable. Five objectives and five research questions were set and five null hypotheses were propounded for the study. Basically, independent sample t-test statistic was used to test all the hypotheses since they are all two variables parametric data. It was observed that problem solving strategy had significant positive effect on students' attitude towards algebra as well as improved the performance of students; it was recommended that Mathematics teachers should be given all needed encouragement and motivation to use the problem-solving method in place of the conventional lecture method for better academic performance. Also, the study recommended that Teachers who had mastery of the subject (algebra) should be encouraged to teaching the rural areas. Finally, the study recommended that for students' attitude towards the learning of mathematics improves, well qualified teachers should be allowed to teach the subject mathematics.

TABLE OF CONTENTS

Contents	Pages
Title	i
Declaration	ii
Certification	iii
Dedication	iv
Acknowledgement	v
Abstract	vi
Table of Content	vii
List of Tables	x
Abbreviations	xii
Operational Definition of terms.	xiii
CHAPTER ONE: THE PROBLEM	
1.1 Introduction	1
1.2 Background of the study	1
1.3 Statement of the problem	3
1.4 Objectives of the study	6
1.5 Research Questions	7
1.6 Research Hypothesis	7
1.7 Significant of the study	8
1.8 Scope of the Study	9
1.9 .Basic Assumptions	10
CHAPTER TWO: LITERATURE REVIEW	
2.01 Introduction	11
2.02 Theoretical Framework	12
2.03 lature and teaching mathematics	17
2.3.1 Mathematics teaching Methods	20

2.3.3	Problem solving teaching Strategy	32
2.04	Lecture method of teaching Mathematics	45
2.0	Academic performance in Mathematics	45
2.04	Attitude and learning of Mathematics	45
2.05	Gender and performance in mathematics at senior Secondary Schools.	53
2.6	Gender and attitude toward Mathematics	57
2.7	Implication of literature review on the Study	61

CHAPTER THREE: RESEARCH METHODOLOGY

3.1	Introduction	62
3.2	Research Design	63
3.3	Population of the Study	64
3.4	Sample and Sampling Technique	65
3.5	Instrumentation	66
3.6	Development of Algebraic test question (ATQ)	67
3.7	Reliability of Instrument	68
3.8	Administration of the Treatment Procedure	69
3.9	Data Analysis Techniques	69
3.10	Ethical Considerations	69

CHAPTER FOUR: DATA ANALYSIS, PRESENTATION AND DISCUSSIONS

4.1	Introduction	75
4.2	Data Presentation	75
4.3	Data Analyses	76
4.4	Summary of the Findings	86

CHAPTER FIVE: SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1	Introduction	87
5.2	Summary	87
5.3	Conclusion	87
5.4	Recommendation	88
5.5	Suggestion for further study.	90
	References	91

APPENDICES:

	Pages
A: Frequency Table	98
B: Pre-Test and Test Reliability using PPMC	105
C: Statistics for Finding Reliability	106
D: Attitude Test Question (ATQ)	107
E: Authorization Letter	109
F: Lesson Plan on Conventional Teaching Method	110
G: Lesson Plan on Problem Solving	121
H: Lesson Plan on Student Centre	139
I: Algebraic Test Questions (ATQ).	149
J: Algebraic Retention Question (ARQ)	155

LIST OF TABLES

TABLE		PAGE
1.1:	No of Student who sat Exam. and Percentage Passed in WAEC from 2010 to 2014 in Kaduna State Educational Zones and Location- - - - -	4
1.2:	No of Student who sat Exam. and Percentage Passed in NECO from 2010 to 2014 in Kaduna State Educational Zones and Location - - - - -	5
2.6:	Nine events of instruction: - - - - -	44
3.3	Population of the study and their education zone within the study area. - - - - -	64
3.4	Sample of the Study - - - - -	66
3.5	Table of specification - - - - -	67
3.6:	SSS Algebra Syllabus - - - - -	70
4.1	Distribution of Bio Data Variables by Groups - - - - -	75
4.2	Distribution of Bio Data Variables by Gender - - - - -	76
4.3	Distribution of Bio Data Variables by school Location - - - - -	76
4.4:	Perception of responses on effect of attitude towards the learning performance of algebra in Mathematics - - - - -	77
4.5	Descriptive statistics on the effect of problem solving method on the mean academic performance of students in algebra - - - - -	78
4.6:	Relationship between the performance of students and their attitude towards algebra - - - - -	78
4.7:	Descriptive statistics for differences in attitude of students who were taught algebra using problem solving technique and those taught using conventional lecture method -	79
4.8:	Descriptive statistics for differences in performance of students who were taught algebra using problem solving	

	technique and that taught using conventional lecture method	-	-	80
4.9:	Descriptive statistics for differences in attitude of male and female students who were taught algebra using problem solving technique	--	- - - - -	80
4.10:	Descriptive statistics for differences in performance of male and female students who were taught algebra using problem solving technique	--	- - - - -	81
4.11:	Descriptive statistics between urban and rural school students in their performance in algebra after Treatment		- -	82
4.12:	Independent Sample t-test Statistics for difference in Attitude between Experimental and Control groups		- - - -	82
4.13:	Independent Sample t-test Statistics for difference in Performance between Experimental and Control groups		- - -	83
4.13:	Independent Sample t-test Statistics for difference in Attitude between Male and Female Students in Experimental Group		- -	84
4.14:	Independent Sample t-test Statistics for difference in Performance between Male and Female Students in Experimental Group		-	85
4.14:	Independent Sample t-test Statistics for difference in Performance between Students from Urban and Rural Schools in Experimental Group		- - - - -	85

ABBREVIATIONS, SYMBOLS AND NOTATIONS

- AAT**--- Algebraic Attitude Test
- ATQ** ---Algebraic Test Questions
- CG** ---- Control Group
- CM**----Convectional Method
- EG**----Experimental Group
- JAMB**---- Joint Admission and Matriculation Board
- SDGS**---Sustainable Development Goals
- MIP**----- Mathematics Improvement Program Project
- NCTM**---National Council for Teachers In Mathematics
- NECO**----National Examination Council
- NERDC**---National Education Research Development Council
- NGO** ----Non Governmental Organization
- PTA**-----Parents Teachers Association
- PS**-----Problem Solving
- SSCE**----Senior Secondary Certificate Examination
- SSS**---- West African Examination Council

OPERATIONAL DEFINITION OF TERMS

Attitude: The feelings students have towards mathematics that could generate to likeness for mathematics or develop math-phobia

Algebra: A branch of mathematics in which signs and letters represents numbers

Control group: Student involve in the study that are taught using the normal conventional method.

Experimental group: Group of student taught using the treatment instrument of problem solving

Performance: Academic performance based on problem solving strategy' teachers serve as a guide for solving problem

Conventional (traditional method): methods used by majority of teachers.

CHAPTER ONE:

THE PROBLEM

1.1 BACKGROUND TO THE STUDY

Mathematics is a body of knowledge centered on concept such as quantity, structure, space and change (Onuh, 2011). Oyifioda (2006) defines mathematics as the science of structure, order and relation that has evolves from elementary practices of counting, measuring and describing the shapes of objects. It involved the abstraction and logical reasoning for counting, calculating measuring and study of shapes and motion of physical objects.

The word mathematics come from Greek word ‘mathema’, which means learning, studying, subject of instruction, science and additionally turned out to have a narrower and a more technical meaning Igomu (2009).. It is a unique aspect of human life and its development and growth has continued from antiquity to the present time. Today mathematics used throughout the world in many fields including science, technical and Art (Nzeni, 2008).

Mathematics as a Subject has been viewed by many as difficult subject (Edeh, 2008). Ibebuike (2006) has noted that many students, even as far back as their primary school days did not take interest in mathematics to a meaningful degree; remarking that methods of instruction were not very favorable to these students. Furthermore, Chima (2002) has hinted that there was no denying fact that mathematics as a subject has acquired the infamous status of student’s enemy number one. It has become such a terrible nightmare and monster to most students that not only fear but also hate it. Today, all fields of knowledge are dependent on mathematics for solving problems and predicting outcomes. It is an indispensable tool in creating new knowledge

The quality of teaching the subject cannot therefore be over emphasized. The effectiveness of many educational systems depends on the type of instructional materials or methods, adopted by the teacher. Obiom (2004) confirms this statement by saying that education unlocks the door to modernization but the method the teacher adopts holds the key. In learning process, it is not all teaching methods, strategies and techniques that lead themselves to the effective teaching of mathematics. Therefore, teachers should use methods that involve learner's active participation such as problem solving, problem centered teaching and mathematical recreation (Games).

Academic problems affecting teaching and learning of mathematics in Nigeria secondary schools include unparallel hatred, indifference and poor attitude toward mathematics education among others (Adebule, 2004).He further explain that various factors affecting the teaching and learning of mathematics in Nigeria at the secondary school level include: political, Economic and academic problems. He stressed further that the academic problem include student unparalleled hatred, indifference and poor attitude toward mathematics among others.

It is common knowledge however, that performance of students in mathematics at the senior secondary school level in Nigeria is not encourage despite the importance attached to it both as academic discipline and as knowledge that everybody need in the society as stipulated by National Policy on Education (FGN) (2013) in Nigeria though different efforts have been made by Researchers, Educationist, government and non-governmental organization (NGOS), The Federal Government of Nigeria established National Mathematical Centre Abuja in Nigeria and one of the school responsibilities of the centre is the improvement of the teaching and learning of the mathematical sciences at all levels.

Also non-governmental organizations have been organizing Mathematics competition e.g Cowbell, Mathematical Olympia, MDGS.

The teaching and learning of mathematics at all levels of educational system can be described to be in a dismal state. Just as students find, it difficult to understand (Amazigo, 2000). The difficulties to students and the poor teaching usually come to light through the poor performance of students .students are seen to perform poorly in both internal and external examination. This every concerned educationist is seeking way out of these problems of poor performance in mathematics. One way is the improvement of the teaching process by introduction of problem solving strategy in our class. Hence, the research “Effect of problem solving strategy on Attitude and performance in Algebra among senior secondary school students in Kaduna state”.

1.2 STATEMENT OF THE PROBLEM

The problem of this study is to analyze the impact of problem solving method on attitude and performance of secondary schools students in Kaduna state, Nigeria. The major concern and important function of the School system is to improve the academic performance of students and produce a pool of skilled manpower that will help a nation grow and develop. Problem solving is at the core of learning in mathematics. Personal classroom experience with secondary school students in Nigeria and results of private and public examination show that most learners are yet to acquire the vital problem solving skills required for success in mathematics.

Mathematics is a subject that majority of the secondary school students are not interested in because of its nature and content (Ojonugwa, 2007). Algebra as one of the major component of mathematics at the senior secondary school is seen as abstractic in nature and cannot be understood by many students as such most questions on algebra are not

attempted in the examination at all or fairly attended to, methodology of instruction is another factor that lead to poor performance in Algebra.. Despite several attempts by parents, stakeholders in education and the government of Nigeria to achieve the formulated objectives of mathematics, it seems that attempts are not yielding positive result in senior secondary schools in Kaduna state hence, the basis for this dissertation effect of problem solving strategy on attitude and performance in algebra among senior secondary school students in Kaduna state.

Table 1.1: No of Student who sat Exam. and Percentage Passed in WAEC from 2010 to 2014 in Kaduna State Educational Zones and Location

Year / Educational Zones	Location	2010		2011		2012		2013		2014	
		N	% pass	N	% pass	N	% pass	N	% pass	N	% pass
Anchau	Rural	3142	8.85	3373	7.26	2240	7.54	2772	0.83	2324	7.10
B/Gwari	Rural	1243	0.87	1105	2.239	642	1.71	686	1.17	509	17.29
Giwa	Rural	2410	9.87	1649	2.42	2919	5.93	2148	1.86	1326	18.33
Kachia	Rural	1370	0.38	1102	2.05	2322	3.66	2022	4.00	1613	12.15
Kaduna	Urban	3062	6.54	3354	1.69	2667	12.97	3185	2.61	1553	35.35
Kafanchan	Urban	3864	7.22	4503	4.04	3770	16.84	4572	3.83	3379	25.63
Lere	Rural	1056	2.69	1328	1.05	1143	0.35	953	3.36	550	26.36
Rigachikun	Urban	1245	1.25	1103	0.18	1538	10.25	2139	6.73	1645	22.49
S/Tasha	Urban	5932	7.60	6262	1.56	5032	9.29	6643	3.10	4923	13.93
Zaria	Urban	5431	11.93	6100	2.270	5022	5.03	5933	2.56	2581	20.88
Godo Godo	Rural	3867	30.80	3518	9.92	3966	13.79	3592	3.00	3734	20.89
Zonkwa	Rural	1126	12.03	1817	7.54	1839	3.86	1646	3.22	1516	24.60
Total		33748		35214		33100		36291		25653	

Source: Kaduna State Ministry of Education ERC (Education Research Centre) Kaduna (2015)

Table 1.2: No of Student who sat Exam. and Percentage Passed in NECO from 2010 to 2014 in Kaduna State Educational Zones and Location

Year / Educational Zones	Location	2010		2011		2012		2013		2014	
		N	% pass	N	% pass	N	% pass	N	% pass	N	% pass
Anchau	Rural	1942	3.36	3598	9.59	2240	2.54	3140	3.61	2980	10.40
B/Gwari	Rural	779	3.92	1182	6.22	645	1.71	978	2.32	84	1.81
Giwa	Rural	2363	5.00	1804	9.02	2919	5.93	2799	2.88	1826	3.24
Kachia	Rural	2664	1.06	1370	7.23	2322	3.66	2418	2.95	1993	4.82
Kaduna	Urban	3667	6.07	3840	7.28	2667	12.97	4072	14.26	2702	9.97
Kafanchan	Urban	2881	0.81	4912	9.39	3770	16.84	5073	7.26	3964	8.92
Lere	Rural	1042	0.10	1993	5.96	1143	0.35	1136	4.20	829	1.72
Rigachikun	Urban	1324	0.35	1386	6.38	1538	10.21	7422	31.22	1973	1.62
S/Tasha	Urban	1146	0.37	6980	7.49	5039	9.29	2341	2.54	5311	32.86
Zaria	Urban	2214	2.12	7140	12.92	5022	5.03	6924	7.78	3222	15.93
Godo Godo	Rural	2016	5.92	3996	10.97	3966	13.79	4821	18.65	4280	6.10
Zonkwa	Rural	1952	2.83	2183	7.54	1839	3.26	1777	3.02	2016	2.86
Total		23990		40384		33110		42901		31180	

Source: Kaduna State Ministry of Education ERC (Education Research Centre) Kaduna (2015)

The Head of National Office WAEC Eguridu (2014 SSCE) in a released result stated that passed rate was 33% and in 2013 SSCE it was 31%. Year in year out parents, guidance and the general public have great concern over the massive failure of students in mathematics (Ojonugwa, 2007). Some of the factors responsible for the failure of students in mathematics in secondary school are:-

- I. Poor mathematics background
- II. Students' negative attitude towards learning mathematics
- III. The quality of the teachers compared with the challenges of teaching mathematics.
- IV. Poor instructional materials.
- V. Sub-standard mathematics laboratory (Ojonugwa, 2007)

Manouchetri (2002) pointed out that good subject matter knowledge alone is not enough for a teacher to teach well, they (teachers) need adequate knowledge of how to teach to enable

them perform well and give out a rich harvest. Bolaji (1990) pointed out that through effective method of teaching, it may be possible to make mathematics lively and less difficult. Hence, it is against this background that the researcher deems it necessary to investigate the effect of problem solving strategy on attitude and performance in Algebra among senior secondary school students in Kaduna state Nigeria.

1.3 OBJECTIVES OF THE STUDY

The main objective of this study was to investigate effects of problem solving strategy on attitude and performance in algebra among senior secondary school students in Kaduna State Nigeria, the other specific objectives are to:-

1. Establish the attitude of student taught Algebra with problem solving strategy (EG) and those taught with conventional method (CG).
2. Find out the difference between performance of student taught Algebra with problem solving strategy (EG) and those taught with conventional method (CG).
3. Investigate the attitude of Male and Female students taught Algebra with problem solving strategy (EG).
4. Find out difference in performance of male and female students taught Algebra with problem solving strategy (EG),
5. Find out if students from Urban and Rural areas taught Algebra with problem solving strategy (EG) differs in performance.

1.4 RESEARCH QUESTIONS

The study was guided by the following research questions:

1. What is the difference between attitude of student taught Algebra with problem solving strategy (EG) and those taught with conventional method (CG)?.
2. What is the difference between performance of student taught Algebra with problem solving strategy (EG) and those taught with conventional method (CG)?.
3. Do Male and Female students taught Algebra with problem solving strategy (EG) differs in attitude?.
4. Do Male and Female students taught Algebra with problem solving strategy (EG) differs in performance?
5. Do students from Urban and Rural areas taught Algebra with problem solving strategy (EG) differs in performance?

1.5 NULL HYPOTHESES

The following research hypotheses were formulated based on the research questions raised and are the null hypothesis tested at 5% level of significance.

HO₁: There is no significant difference between the attitude of student taught Algebra with problem solving strategy (EG) and those taught with conventional method (CG).

HO₂: There is no significant difference between the average performance of student taught Algebra with problem solving strategy (EG) and those taught with conventional method (CG).

HO₃: There is no significant difference between the attitude of male and female students taught Algebra with problem solving strategy (EG)

HO₄: There is no significant difference between the average performance of male and female students taught Algebra with problem solving strategy (EG)

HO₅: There is no significant difference between the average performance of students from urban and rural areas taught Algebra with problem solving strategy (EG)

1.6 SIGNIFICANCE OF THE STUDY

The study would provide adequate information on the importance of using problem solving method in solving Algebraic problems in mathematics. This study would contribute immensely by reducing the general mathematics phobia worrying students at post-basic level of education due to the use of ineffective instructional strategies by mathematics teachers

The findings of this research would reduce the distaste students and their teachers have towards teaching and learning algebra as a difficult area in mathematics. They would come to realize that with the application of suitable methods of teaching, algebra can be easily taught and learnt.

The study would also, provide teachers, curriculum and textbook developers with relevant materials that may be used to improve the teaching and learning algebra at SSS level. This study could also, help to provide empirical basis for improvement and modification of the methods of teaching mathematics which could be of special interest to curriculum planners, authors of textbooks and students. Such improvement and modification could also make parents to be happy to see that their children are passing mathematics for their future educational progress.

It is also hoped that the findings of the study would stimulate and promote further researches. Professional organizations in mathematics like Mathematical Association of

Nigeria (MAN), curriculum development organizations like Nigeria Educational Research and Development Council (NERDC) and even individual mathematics educators will find the results worthy of discussion and dissemination to stimulate and promote further researches.

1.7 SCOPE/DELIMITATION OF THE STUDY

The main point of the research is to determine the effectiveness of problem solving for teaching Algebra at senior secondary school in Mathematics in Kaduna State. The study covered only the senior secondary schools thus were faced with some limitation.

The study is limited to only SSS in Kaduna State; private and junior secondary schools are not included in the study. However, the result of the research can be applied to those not included in the study as Algebra is taught from the primary school level of educational system in Nigeria to tertiary level.

Another limitation is in the numbers of schools used in the research. Four schools are used, two in the urban and two in the rural area which included two girls' schools and two boys' schools

However, as delimitation, the study did not go into other causes of poor performance beyond the issue of teaching methods. The study did not also, treat other topics of mathematics such geometry, number and numeration and statistics as the study was only confined to algebraic aspect of mathematics.

1.8 BASIC ASSUMPTIONS

1. That the students in senior secondary school had learned the content of Algebra in mathematics as stipulated in the National curriculum by NERDC.
2. The schools that will be chosen for the study have similar teaching and learning facilities and resources.
3. All teachers who take these students who were sampled were trained and had good mastering of Algebraic content and have good teaching strategies

CHAPTER TWO

REVIEW OF RELATED LITERATURE

2.1 INTRODUCTION

The purpose of this study is to investigate the effect of Problem Solving Instructional Method on Attitude and performance in Algebra among Secondary School Students in Kaduna State. The chapter reviewed literature related to the study on attitude towards learning and performance in Algebra at senior secondary school. Literature reviewed was cited both from within Nigeria and from studies done outside Nigeria. The review for better understanding was organized under the following subheadings:

- 2.2 Theoretical Frame Work
- 2.3 Nature and Teaching of Mathematics at Senior Secondary School.
 - 2.3.1 Mathematics Teaching Methods
 - 2.3.2 Problem Solving Teaching Strategy
 - 2.3.3 Lecture Method of Teaching Mathematics
- 2.4 Academic Performance in Mthematics
- 2.5 Attitude and Learning Mathematics
- 2.6 Gender and Performance in Mathematics at Senior Secondary School.
 - 2.6.1 Gender and Attitude towards Mathematics
- 2.7 Location and Performance
- 2.8 Overview of Similar Studies
- 2.9 Implication of Literature Review on the Study.

2.2 Theoretical Frame Work.

Ojoko (2001) defines teaching as the art and science of directing the learning process. According to him, teaching is often viewed narrowly as a process of imparting knowledge and skills in developing attitudes, it is also entails managing instructional facilities and equipment providing and organizing learning materials and resources and meeting students' needs. However, Gbamanja (2001) states certain principles of teaching to include:

- i. Planned teaching results in more teaching
- ii. Students tend to achieve in ways they are tested
- iii. Students learn more effectively if they know the objectives and are shown how to gain the ends.
- iv. The teachers function in the learning process is that of guidance to reach an objective and that pupils learn from one another.

He pointed out that the problem of simulating students to be thrilled with learning and gaining the zest for Education that will continue for life is an elaborate task. Furthermore, he pointed out that the teaching profession is concerned fundamentally with the attainment of maximum beneficial learning for the individual. It is the teachers' task to ensure that learning is efficient and effective in order for students' to discover their human potential.

Invariably, methods of teaching are derived from four modes of teaching as postulated by Gbamanja (2001). These four mode of teaching are didactic model, heuristic mode, philetic mode and the guristic mode. He further explained that the didactic is the telling mode of teaching. Activities of this mode include: lectures, assignments, recitations and examinations. The content of this mode of teaching is traditional subject matter.

The heuristic mode involves the inquiry and discovery methods. Here, the teacher act as an arranger, organizing inquiry/discovery activities to facilitate meaningful learning. Activities

of this mode include organizing learners, giving criteria, holding conferences and checking progress of students. However, the philechic mode of teaching is the affective style and it involves the arousal of student's feeling or opinions. A philetic teacher is a friend, counselor and a 'parent'. The teachers who operate in this mode create moods and a performer of things for the enjoyment of students. All these activities are focused on the ego of the learner.

The guristic mode of instruction involves the teacher explaining his experiences or feelings. There is no motive to teach, no desire to impact any of the above three modes. From the teachers' information about his own view of life, students pick out what their lines of interest are. The guristic teacher is a good interpreter of the future. He sees the future and imagines for the learner. His major activity involves reflective thinking.

However, various methods of teaching include lecture method, discussion method, demonstration method, project method, field trips, discovery inquiry method, laboratory methods, the process approach, individualized learning methods, and questioning methods. These methods of teaching are embedded in the mode of teaching enumerated above. While method is a way of doing something or an approach adopted by a teacher to explain a subject matter to a group of students or learners; methodology means the study and practices of various methods of teaching and it involves all the things a teacher would do to enhance teaching and learning. There include different teaching methods, clear statements of instructional objectives; learning resources, presentation, skills, writing and following a good lesson plan.

Ojoko (2001) identifies several methods that science teachers could use in presenting scientific information, principles and skills to the learners. These include discovery or inquiry method, fieldtrip, discussion method, demonstration method and the laboratory

method. He opined that success of these methods of teaching depends largely on two factors. The use of teaching aids by the teacher and the use of motivation by the teacher.

In his contribution to the approach of teaching mathematics, Salau (2002) posited that the very nature of mathematics is abstract and extra effort is required to bring students to understand its underlying concepts, principles and applications. Specifically, many principles and concepts in mathematics are not easily explained with common sense deduction. This obviously adds to the difficulty students encounter in the comprehension of mathematics generally, notably, examples of these concepts are symmetry, place value, addition, subtraction, number system, Algebra, Geometry, probability as well as longitude and latitude to mention but a few. The abstractness of these concepts requires so much recourse to using concrete instructional aids.

Algebra

Algebra (from algebra Arabic “al- jabr” meaning “re-union of broken parts) is one of the broad parts of mathematics, together with number theory, geometry and analysis. In its most general form, algebra is the study of mathematical symbols and the rules for manipulating these symbols.

Historically, algebra is the study of solution of one or several algebraic equations, involving the polynomial functions, of one several variables. The case where all the polynomials have degree one (systems of linear equations) leads to linear algebra. The case of a single equation, in which one studies the roots of one polynomial, leads to field theory and to the so- called Galois theory. The general case of several equations of high degree leads to algebraic geometry, so named because the set of solutions of such systems are often studied by geometric method.

Algebra is a branch of mathematics most people who have gone through secondary school would have studied at some stage: it introduces symbols (such as x , y , z etc) and a series of mathematical operation like factorization, expansion etc. it can be studied from a very elementary level (like addition and simplification of Algebraic fractions, solving simple simultaneous linear equation involving two unknowns up university levels and beyond where one studies complex linear systems, determinants, matrices, Eigen values, vector space, fractals etc.

Areas of mathematics with word algebra in their name

- I. Elementary algebra, the part of algebra that is usually taught in elementary courses of mathematics.
- II. Abstract algebra, in which algebraic structures such as groups, rings and field are axiomatically defined and investigated.
- III. Linear algebra, in which the specific properties of linear equation, vector spaces and matrices are studied.
- IV. Commutative algebra- the study of commutative rings.
- V. Computer algebra, the implementation of algebraic methods as algorithms and computer programs.
- VI. Homological algebra, the study of algebraic structures that are fundamental to study topological spaces.
- VII. Universal algebra- in which properties common to all algebraic structures are studied.
- VIII. Algebraic number theory, in which the properties of numbers are studied from an algebraic point of view.

IX. Algebraic geometry, a branch of geometry, in its primitive form specifying curves and surfaces as solutions of polynomial equations.

X. Algebraic combinatory, in which algebraic methods are used to study combinatorial question.

The roots of algebra can be traced to the ancient Babylonians, who developed an advanced arithmetical system with which they were able to do calculation in an algorithmic fashion. The Babylonians developed formulas to calculate solutions for problems typically solve today by using linear equations, quadratic equation and indeterminate linear equations. By contrast, most Egyptians of this era, as well as Greek and Chinese mathematics in the 1st millennium BC, usually solved such equation by geometric methods, such as those described in the Rhind mathematical papyrus, Euclid, Elements and the nine chapters on the mathematical Art.

In the context where algebra is identified with theory of equations, the Greek mathematician Diophantus has traditionally been known as the "father of algebra" but in more recent times there is much debate over whether al-Khwarizmi, who founded the discipline of Al-Jabrab, deserves that title instead. Those who support Diophantus point to the fact that the algebra founded in Arithmetica and that Arithmetica is syncopated while Al-Jabrab is fully rhetorical. Those who support Al-Khwarizmi point to the fact that he introduces the method of "reduction" and "balancing." Persian mathematician Omar Khayyam is credited with identifying the foundations of algebraic geometry. Yet another Persian mathematician Sharaf al-Din al-Farsi developed the concept of function. The Indian mathematicians Mahavira and Bhaskara II, the Persian mathematician Al-Karaji and the Chinese mathematician Zhu Shijie, solve various cases of cubic, quintic, sextic and higher-order polynomial equations using numerical methods in the 13th century. The solution of a

cubic equation by Fibonacci is representative of the beginning of a revival in European Algebra. As the Islamic world was declining, the European world was ascending. And it is here that algebra was further developed.

2.3 Nature and Teaching of Mathematics

Every individual needs mathematics knowledge to function intelligently and efficiently in his or her world. Mathematics is one subject that is an integral part of every one's life and affects virtually every field of human endeavour. An average man needs mathematics to survive no matter how rudimentary. There is no doubt about the fact that an individual can get on sometime without knowing how to read and write, but can never push on smoothly without knowing how to count measure, add and subtract (Anaduaka et al 2013). The many uses and applications of mathematics in home, office, in business, in industries, in agriculture, in decision making and even in governance abound and innumerable. Usman (2002) noted that everywhere one go, everything are or prose to do, either the structure of mathematics or its applications play a vital role and this is why most countries, races and peoples put emphasis in all aspects of studying, developing and applying mathematics.

Saint Paul public school (2007) commenting on the importance of mathematics stated that the study of mathematics helps the mind to reason and organize complicated situation or problems in to clear, simple and logical step. The reality they noted is that in a society such as ours, high paying jobs often demand someone who can simplify complicated situations and reduce item to the level everyone can understand. They therefore insisted that by knowing more mathematics, students give themselves the competitive edge they need to vie for such high paying jobs.

The objectives of Teaching Mathematics in secondary schools make it very important as a foundation subject for success in further academic endeavor and manpower development.

In view of this, the learning of mathematics in schools, as observed by Osafehinti and Odili in Musa et al (2014), represents first, a basic preparation for adult life and secondly a gateway to a vast array of career choices. In this respect, Iji in Musa (2014), maintained that any country that aspire for national growth in science, industries, and technology must not neglect mathematics.

The Nature of Mathematics

Mathematics relies on both logic and creativity, and it is pursued both for a variety of practical pursued and for intrinsic interest. For some people, and not only professional mathematics, the essence of mathematics lies in its beauty and its intellectual challenges. For others, including many scientist and engineers, the chief value of mathematics is how it applies to their own work. Because mathematics lays such a central role in modern culture, some basic understanding of the nature of mathematics is requisite for scientific literacy. To achieve this, students needs to perceive mathematics as part of the scientific endervour. Comprehend the nature of mathematics thing, and become familiar with key mathematical ideas and skill.

Pattern and Relationship

Mathematics is the science of patterns and relationships. As a theoretical discipline, mathematics explores the possible relationship among abstractions without concern for whether those abstractions have counterpart in the real word. The abstractions can be anything from strings of numbers to geometric figures to set of equations. Part of the sense of beauty that many people have perceived in mathematics lies not in finding the greatest elaborateness or complexity but on the contrary, in finding the greatest economy and simplicity of representation and proof. Mathematics is also an applied science. Many mathematicians focus their attention on solving problems that originate in the world of

experience. They too search for pattern and relationships. Theoretical mathematics, unlike the other science is not constrained by the real world but in the long run it contributes to a better understanding of that world.

Mathematics, Science and Technology

Because of its abstractness, mathematics is universal in a sense that other fields of human thought are not. It finds useful applications in business, industry, music, historical scholarship. Politics, sports, medicine, agriculture, engineering, and the social and natural science. The relationship between mathematics and the other field of basic and applied science is especially strong. This is so for several reasons including the following.

Science provides mathematics with interesting problems to investigate, and mathematics provides science with powerful tools to use in analyzing data. Mathematics is the chief language of science. The symbolic language of mathematics has turned out to be extremely valuable for scientific idea unambiguously. The statement $a = F/m$ is not simply a shorthand way of saying that the acceleration of an object depends on the force applied to it and its mass; rather it is a precise statement of quantities relationship among those variable, mathematics and science have many feature in common, these include a belief in understandable order; An interplay of imagination and rigorous logic; ideas of honesty and openness.

Mathematics and technology have also developed a fruitful relationship with each other, the mathematics of connection and logical chain, for examples, has contributed greatly to the design of computer hard ware and programming techniques.

Mathematical Inquiry

Using mathematics to express idea or to solve problems involves at least three phases.

- I. Representing some aspects of things abstractly.
- II. Manipulating the abstractions by rules of logic to find new relationships between them.
- III. Seeing whether the new relationships say something useful about original things.

Abstractions and Symbolic Representation

Mathematical thinking often begins with the process of abstraction – that is, noticing a similarity between two or more objects or events. Aspects that they have in common whether concrete or hypothetical can be represented by symbols such as numbers, letters, other marks, diagram, geometrical constructions or even words. Whole numbers are abstractions that represent the size of sets of things and event or the order of things within a set. The circle as a concept is an abstraction derived from human faces, flower, wheels or spreading ripples.

However, various methods of teaching mathematics at SSS include lecture method, discussion method, demonstration method, project method, field trips, discovery / inquiry method, laboratory methods, the process approach, individualized learning methods and questioning methods.

2.3.1 Mathematics Teaching Methods

The methods of teaching mathematics include among others the following

- I. Model teaching method
- II. Socratic method
- III. Classis Socratic method
- IV. Modern Socratic method
- V. Kumon method
- VI. Lecture method

VII. Deductive method

VIII. Inductive method

IX. Project method

Model Teaching Method

This technique of model building is a visual way of picturing a situation. Model building involves using blocks or boxes to solve the problem instead of forming simultaneous equations and solving for variable.

The power of using model can be best illustrated by problems, often involving fractions, ratios or percentage, which appear difficult but if models can be draw to show the situation, the solution becomes clearer, sometime even obvious.

Advantages of Model Method

- I. Pictorial representation of abstract relationships.
- II. Fewer (and less abstract) rules to learn,
- III. Intuitive, easy to understand by students,
- IV. Flexible, applying in many situations,
- V. Giving students a way to visualize equations.

Disadvantages of Model Method

- I. Pictorial approach may not be intuitive to some students
- II. May not work in every situation
- III. Take plenty of practice to learn to use well

Socratic Teaching Method

- I. Teaching by asking instead by telling
- II. Involves asking a series of question until a contradiction emerges invalidating the initial assumption

III. Socratic irony is the position that the inquisitor takes that he knows nothing while leading the questioning.

IV. Just asking a lot of questions does not automatically constitute a use of Socratic method

V. The oldest, and still the most powerful, teaching tactic for fostering critical thinking

VI. Focus is on giving students question, not answers

VII. Socratic questioning is highly disciplined process.

The Classic Socratic Method

Is freestyle because, due to the nature of the questions, it cannot predict the response to the questions, anticipate the flow of the conversation even know if a satisfactory answer is possible.

The Modern Socratic Method

Is often constrained to a predesigned set of questions that are known to generate a range of predictable answer that elicit knowable facts. This method can be used to good effect for leading a person to work out their own understanding of static knowledge such as mathematics.

Socratic questionnaire should:

I. Keep the discussion focused,

II. Keep the discussion intellectually responsible,

III. stimulate the discussion with prolong answer,

IV. Periodically summarize what has and what has not been dealt with and/ or resolved.

V. Draw as many students as possible into the discussion.

Advantages of Socratic Method

The Socratic method of teaching has been used by schools and teachers for many generations. However, it is often more used in higher education, which comes as a disadvantage to young students. Young student should be taught by Socratic method because it encourages critical thinking, in-class participation, and other social skills that students will need to succeed at any level of education

- I.** Easy to understand principle.
- II.** Involves discussion
- III.** Students can actively engage with their knowledge instead of simply memorizing or retaining it.
- IV.** Students can exchange opinions and ideals develop excellent speaking and communication skills
- V.** The Socratic Method is a fun yet educational way to teach the students how to make use of their knowledge. The Socratic method also teaches students how to think critically, accept others' opinions or viewpoints, and apply their knowledge to real world and to other forms of knowledge.

Disadvantage of Socratic Method

- I.** Assume everyone knows nothing
- II.** Difficult to apply
- III.** It is imperative to know you can be wrong
- IV.** Socratic was called wise by the oracle and others because he was wise enough to understand that even he knew nothing.

Kumon Teaching Method

- I.** Founded in 1958, by senior high school Math teacher Toru Kumon

II. Individualized learning method

III. The starting point for each Kumon students is determined individually. Students start with the level where they can attain a perfect score by studying on their own.

IV. The worksheets have been designed in a way that allows student to figure out how to solve problems on their own. Kumon pursues the potential of each individual with the individualized, self-learning method.

V. Based on individualized instruction and study at the “just right” level, Kumon seeks to improve the skills of each student and maximize their potential.

Kumon’s Mission

By discovering the potential of each individual and developing his/her ability to the maximum aim to foster sound, capable people and thus contribute to the global community.

Kumon’s Vision

“world peace through education”.

Kumon’s vision is really quite simple, and yet incredibly humanistic. The vision of world peace through education will be realized by the fostering of as many capable individual as possible. Such individual will progress the skills to overcome hardships and difficulties using their own innate abilities. By doing so, we believe that we can realize our vision, world peace, for a well-educated community made up of capable individual will be a peaceful community.

Advantages of Kumon Method

I. Individual learning. The path of study is tailored according to student’s abilities. The starting point, daily work load, projection, amount of repetition rate of advancement, is all designed with each individual in mind.

- II. Easy starting point: You may be surprised at the easy starting point is set for the students. The easy starting point is set so that students can begin their Kumon experience with success, attaining 100% with each set and starting to build confidence in mathematics. It is also important for other reasons.
- III. Daily study: Kumon is a daily program. The students spend only 10-30 minutes a day to do the work sheets. This will instill in them good study habits and self discipline. Constancy and continuity are great assets for the future education as well as self development.
- IV. Repetition: Repetition are one of the reasons for Kumon's success. It gives students adequate time to consolidate and master each area covered in the Kumon program. So it is quite normal and natural for students to be asked to repeat worksheets that have already been completed.

Deductive Method of Teaching

The deductive starts with a rule that is applied to specific cases for the purpose of testing its validity, illustrating or further developing it, or solving the problem to which it applies. Process of thought starts from general going to particular.

Step of the Deductive Method

- I. Statement of the problem: The problem should be motivating and should arouse a desire to solve it. As much as possible, should be real, vital and within the ability and maturity of the student.
- II. Generalization: Two or more generalizations may be recalled. One of these will be the solution to the problem.
- III. Verification: This is trying out and securing the successful generalization.

Advantages of Deductive Method

- I. Students think logically and scientifically
- II. What is learned is retained longer and is better understood.
- III. Students are trained in problem solving and are able to solve similar problems later

Disadvantages of Deductive Method

- I. It does not fit all subject matter areas.
- II. It requires more time and is mentally taxing for slow learners.

Inductive Method of Teaching

Inductive method solve problem from the particular to the general, through the inductive procedure, one may arrive at a fact, a principle, truth or generalized. It helps students to discover important rules or truths for themselves through careful observation of among specific examples that will support the generalization, it makes meanings, explanations, and relationships of ideas clear to students and enables them to carry investigations for themselves independent of the teacher, through the master of the inductive procedure.

The presentation of inductive method is from specific cases or instances which are presented to the class. There should be enough cases from which to draw a generalization. It is better to have more rather than too few cases. Otherwise, conclusion from very few instances.

Comparison and abstraction of inductive method step is that the common element among the specific cases is delivered. Each case should be gone over as this is the step that prepared the student to state the generalization.

Generalization: The common fact deduced from the specific instance is stated as generalization, a rule, a definition, principle, or formula. The students' ability to state the rule by themselves is the test of the success of the lesson.

Application: This step test students understanding of the rule or generalization just developed. They should be able to apply it to other problems or exercises, if they understood it.

Advantages of Inductive Method

- I. It makes the student think logically and scientifically
- II. What is learned is retained longer and is better understood
- III. The students are trained in problem solving and are able to solve similar problems later.

Disadvantages of Inductive Method

- I. It does not fit all subject matter areas.
- II. It requires more time and is mentally taxing for slow learners.
- III. Lack of available resources for the proper performance of activities.

Project Teaching Method

This method aims to bring practically designed experience into the classroom. Often conducted over a period of three to six months, the project gives students an opportunity to work in a team environment and apply theory learned in the classroom. There are some parts of the curriculum in which students are necessarily dependent on the teacher and others in which they can work more independently.

Project work is more likely to continue the more informal part of the program, the part where they have greater autonomy in the development of their work than when involved in teacher directed instruction.

Other teaching strategies could include cooperative and collaborative learning. Collaborative learning is a method of teaching and learning in which students' team together to explore a significant question or create a meaningful knowledge. Cooperative learning is a specific kind of collaborative learning where students work together in small groups on a structured activity they are individually accountable for their work and the work of the group as a whole is also assessed. Cooperative groups work face-to face and learn to work as team.

Why cooperative and collaborative learning? Paradigm shift of education CALLS for the departure from the traditional teaching methods which are primary teacher centered into student centered learning environment.

Cooperative and collaborative learning emphasis on the following:

- I. Socialization
- II. Externalization
- III. Combination
- IV. Internalization

Socialization: involves the sharing of knowledge between individuals.

Externalization: This requires the expression of tacit knowledge and its translation into comprehensive forms that can be understood by others.

Internalization: Where newly created knowledge is converted from explicit knowledge into the organization's tacit knowledge.

Spiral model described the integration of cooperative and collaborative learning and teaching as:

1. The interactions between these kinds of knowledge lead to the creation of new knowledge.

Socialization externalization combination

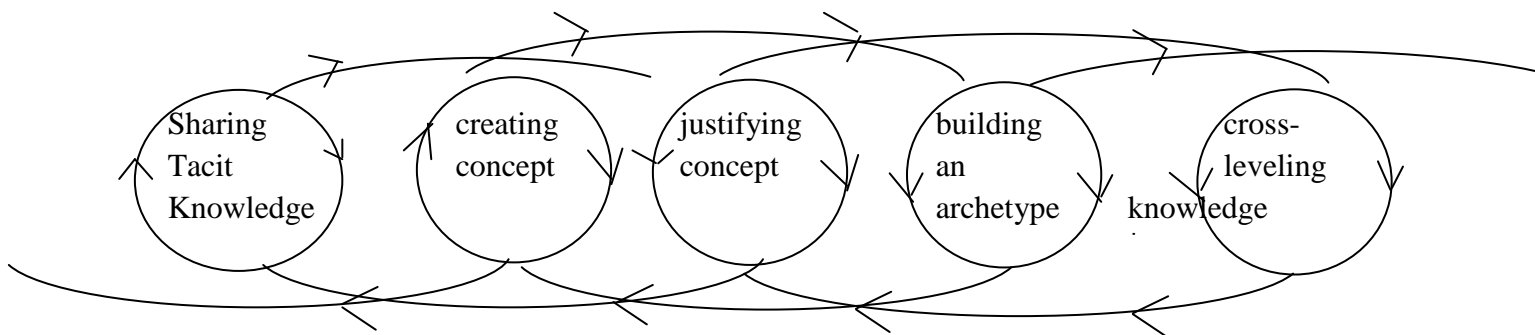


Fig 2.4 five-phase smodel of the organizational knowledge-creation process.

(Nonaka & Takeuchi, 1995, p.84)

Tacit knowledge is highly personal and hard to formalize. Subjective insight, intuitions, and hunches are examples of tacit knowledge. Explicit knowledge is the ones that are learnt in the school. These knowledge are created through classroom session, on the job training and field trips

Model for Cooperative and Collaborative Teaching

There are plenty of model for cooperative and collaborative teaching strategies such as JIGSAW. PUZZLE and THINK- PAIR SHARE.

Jigsaw Method

The jigsaw method is a cooperative learning/teaching technique in which students work in small groups. Jigsaw can be used in a variety of ways for a variety of goals, but it is primarily used for the acquisition and presentation of new material, review, or informed debate.

How does the jigsaw method work?

- 1 .In this method, each group member is assigned to become an ‘ ‘expert’ ’ on some aspect of a unit of study.
2. After reading about their area of expertise, the experts from different groups meet to discuss their topic and then return to their topic and take turns teaching their topics to their group mates.

This Method Allows for:

- I. An efficient way to learn content.
- II. Development of listening, engagement, and empathy skills.
- III. A way for students to work independently
- IV. Interaction among all students.

Think –pair – share method:

It is a cooperative discussion strategy developed by Frank Lyman and his colleagues in Maryland. The name is from the three stages of student action, with emphasis on what students are to be doing at each of those stages.

How does it work?

1. Think

The teacher provokes students' thinking with a question or prompt or observation.

- I. The students should take a few moments (probably not minutes) just to think about the question.

1. **Pair**

Using designated partners, nearby neighbors or a desk mate, students' pair up to talk about the answer each came up with. They compare their mental or written notes and identify the answers they think are best, most convincing, or most unique

2. **Share**

- I. After students talk in pairs for a few moments, the teacher calls for pairs to share their thinking with the rest of the class.
 - II. They can do this by going around in round-robin fashion, calling on each pair; they can take answers as they are called out (or as hands are raised)
 - III. Often, the teacher or a designated helper will record these responses on the board or on the overhead. Example

Learning Task:

The teacher will provide a word problem involving an area.

Think:

The teacher will allow the students to individually solve the problem first

Pair:

- I. After 5 minutes, the teacher will ask the students to find a partner, and discuss their solution to each other.
- II. They should come up with a single solution for the given problem

III. While partners are discussing their solutions, the teacher will roam around to see which partnered students were able to make it correctly and which are not.

Share:

The teacher will randomly select a partner to share their solution to the class by explaining it in front and solving it using the blackboard

In mathematics, as in no other science, is great distance between school content and current research. Contents of school mathematics almost do not change, and what is constantly changing is the intensity of their processing. Therefore, the problem is not on emphasized for complete adopting of such content. The problem is in didactic development of these materials.

Teaching mathematics in secondary schools is a completely decentralized system which is controlled by the administrative bodies at various levels (nation or local). As a result of this situation, there are no standard models for teaching mathematics. In such condition everyone finds their best model.

For good lessons it is necessary to chose or combines different methods for teaching mathematics which is very difficult. To find the best method of teaching, to develop effective rationales of lesson-planning, and even to theoretically model the teaching learning process in adequate way.

Selection of methods depends on subject, level of student knowledge, number of students in group, technical possibilities, working environment etc. Teachers and students both have to try to do their best for reaching the main goal knowledge.

2.3.2 PROBLEM SOLVING TEACHING STRATEGY

Lester (1990) stated that mathematical problem solving is a set of actions taken to perform a task. Krulick and Rudrick (1980. P.4) posit that mathematics problem solving is ‘a

process the means of which an individual uses previously acquired knowledge, skills and understanding to satisfy the demands of unfamiliar situation". Polya (1957) suggested that mathematical problem solving is to find way where no way is known offhand, it is to find a way out of difficulty and it is to attain end.

National Council for Teachers of Mathematics (2000) NCTM describes problem solving based teaching as:

Using interesting and well selected problems to launch mathematical lesson and engage students. In this way, new ideals, techniques and mathematical relationship emerge and become the focus of discussion. Good problems can inspire the exploration of important mathematical ideals, nurture persistence, and reinforce the need to understand and use various strategies mathematical properties and relationship (P.182)

This succinct statement encompasses ion two decades of research and a reflection of the entire gamut of issues that are related to problem solving in mathematics education. Even through, researchers have continued to grapple with the issue of problem solving through teaching. Research studies have also emphasized the role of the teacher in developing students' reasoning skills in problem solving. Weber (2008) averred that to lead students to develop accurate criteria for what constitutes a good argument, the teacher must have a solid understanding of such criteria.

In the same vein, the National policy on Education (FRN 2004) stressed the need for basic knowledge and application of mathematics, science and technology, for purposeful and meaningful economic development, particularly in the modern age of technological advancement of the nation. The policy also indicate that the teaching of problem solving in the classroom in very essential in order to prepare the students for problem solving

challenges outside the four walls of the classroom. The art of problem solving is the heart of mathematics. Hence, mathematics instruction should be designed to enable students appreciate mathematics as an instrument of problem solving. Mathematics problem solving is seen as a complex process that often threatens both the teachers and students. The only way to reduce its difficulty is by the teaching it in a systematic and step by step manner.

This implies that the goals of education to be achieved, problem solving skills and competencies of students in handling mathematics problem solving must be built or enhanced right from the secondary school level by exposing them to different strategies that are in practice. Therefore, this study seeks to find out the effect of problem solving strategy on Attitude and performance in Algebra among senior secondary school students in Kaduna State, Nigeria.

Problem Solving Method

This method aims at presenting the knowledge to be learnt in the form of a problem. It begins with problematic situation and consists of continuous meaningful well integrated activity. Choose a problem that uses the knowledge that student already have i.e you as a teacher should be able to give them the problem and engage them without spending time going one the things that you think they should know. After students have struggled with the problem to get solution, have them share their solution. This method will help them in developing divergent thinking.

The Sequence of Problem Solving Techniques in Mathematics

Ojo (2008) stimulated the following steps:

Step 1: Identifying the Problem

The problem should be identified out of the experience of each student and placing the problem before the students in the class or individually as the occasion demand. The

teacher should help in providing students with sources of information which could help providing students with sources of information which could help identifying the problem. He should guide the students in analyzing the information obtained so as to formulate problem. The teachers should guide the students with the aid of questions and others techniques of teaching.

Step ii: Defining and Delimiting the Problem

The student should read the problem first in order to comprehend the general manner. He should re-read the problem more. Thoroughly with a view to finding out what he is expected to do. The problem should be interpreted it should be narrowed down to a manageable size.

Step iii. Proposing hypothesis

The student is expected to plan alternative mathematics behaviours that can be utilized in solving the problem. He/she should formulate tentative solution (s) – a hypothesis, for solving the problem.

Step iv. Collection of data and other evidence

The students should collect or gather relevant data and others evidence from different sources that has bearing on the problem and which can help him in solving the mathematics problem.

Step v. Trying out the hypothesis

He establishes a relationship between the different unknowns in the problem with the help of a diagram where possible. He carries out the required operations and performs the necessary calculations in order to arrive at the answer

Step vi. Verification

The student should check the reasonableness of the solution obtained by seeing how it fits the conditions of the identified problem. If the solution is supported, then the problem is solved. Otherwise, the approach is revised and the process is repeated until the answer is obtained. This may require trying out an alternative hypothesis rather than one used earlier on.

The Role of the Teacher in Problem Solving

- I. Moderate the motivation of the students
- II. Encourage divergent thinking in students.
- III. Present the problem as a whole
- IV. Moderate the difficulty level of the problem
- V. Allow for active participation on their students
- VI. Encourage students to practice on their own
- VII. Allow students to complete the solution to a problem.

Uses of Problem Solving

In stating the uses of problem solving Taplin (2004) synthesized the various uses of problem solving in mathematics which include:-

- I. Problem solving facilitates students-student and student-teacher interactions.
- II. Is a forum where the teacher has a fair and objective assessment of the students' ability?
- III. Problem solving provides a flexible teaching session with the teacher knowing when, where and how to intervene
- IV. Problem solving places teacher's role as a guide, as a leader and as an instructor.
- V. Problem solving provides for students to discover laws and rules in mathematics.
- VI. Problem solving provides the student to discover the answers by themselves

VII. Problem solving makes the whole lesson more interesting.

However, professional organizations such as the Nation council of teachers of mathematics (NCTM, 1980 and 1989) have recommended that the mathematics curriculum should be organized around problem solving, focusing on:

- I. Developing skills and the ability to apply these skills to unfamiliar situations.
- II. Gathering, organizing, interpreting and communicating information.
- III. Formulating key questions, analyzing and conceptualizing problems, defining problem and goals, discovering patterns and similarities seeking out appropriate data, experimenting, transferring skills and straight to new situations.
- IV. Developing curiosity, confidence and open-mindedness (NCTM,) 1980, pp. 2-3)

The ultimate goal of any problem- solving program is to improve students' performance at solving problems correctly. The specific goals of problem- solving in mathematics are to:

- I. Improve pupil's willingness to try problems and improve their perseverance when solving problems.
- II. Improve pupil's self concepts with respect to the abilities to solve problems
- III. Make pupil's aware of the problem solving strategy.
- IV. Make pupils aware of the value of approaching problems in a systematic manner.
- V. Make pupils aware that many problems can be solved in more than one way.
- VI. Improve pupil's abilities to select appropriate solution strategies
- VII. Improve pupils' abilities to implement solution strategies accurately.
- VIII. Improve pupils' abilities to get more correct answers to problems.

Some Problem Solving Models

The following are some of the most common models that are used in mathematics and discipline as a model to impact knowledge:

- I. The Polya Model: Polya (1957) pioneered a literature in problem solving. He modestly claimed that his model for problem solving was general and could exert some good influence on the teaching of Mathematics. Polya divides the acts of problem solving into four stages which include:

Stage I: understanding the problem itself.

Stage II: Devising of a set of plans for attacking the problem or from previous experiences.

Stage III: Carry out the plan of solving the problem.

Stage IV: Looking back, that is examine the obtained solution.

2. The scopes model: Scoope's (1973) develop another problem solving model which involves the following stages:

- I. Trial and error stage
- II. Systematic pattern stage
- III. Rephrasing stage.
- IV. Insight stage.
- V. Insight justification stage.
- VI. Generalization stage.

3. The Rubenstein's Model: Rubenstein (1975) identifies four processes that are involved in problem solving activity. These include:

- I. Preparation stage.
- II. Incubation stage.

- III. Inspiration stage.
 - IV. Verification stage.
4. The Krulik and Rudnick's Model: Krunlik and Rudnick (1980) proposed a five-step model for problem solving. These include:
- Step I: Read the problem.
 - Step II: explore the possibilities.
 - I. Step III: select a strategy.
 - II. Step IV: solve
 - III. Step V: Review and extend.
5. The Leutzing Model: Leutzing (1985) evolved a problem-solving model known as "four-stops", the four-stops are as follows:
- Stop I: Read the problem.
 - Stop II: Diagram or represent the problem.
 - Stop III: Set up the calculation and compute.
 - Stop IV: Write the answer.

To ascertain the effect of problem solving strategy on attitude and performance in Algebraic among senior secondary schools students in Kaduna State, Nigeria, the researcher combine the Polya model and the Scoope's model to teach. This is in the suggestion of Musa (2014) - it is important to appreciate the fact that no one model is sufficient for all topics and for all problem situations and for all Mathematics lessons.

2.5.3 LECTURE METHOD OF TEACHING MATHEMATICS

The lecture method is just one of several teaching methods. The word lecture comes from the Latin word Lectus, from form 14th century, which translates roughly into "to read". The term lecture, then, in Latin, means "that which is read". It wasn't until the 16th century that

the word was used to describe oral instruction given by a teacher in front of an audience of learners

Today, lecturing is a teaching method that involves, primary, an oral presentation given by an instructor to a body of students. Many lectures are accompanied by some sort of visual aid, such as a slideshow, a word document, an image, or a film, some teachers may even use a whiteboard or a chalkboard to emphasize important points in their lecture, but a lecture doesn't require any of these things in order to qualify as a lecture. As long as there is an authoritative figure (in any given context) at the front of a room, delivering a speech to a crowd of listeners, this is a lecture.

The "lecture method" in the Math classroom is a means by which "the expert" presents the materials of the course in an organized way to "the learners", going from theory to examples and back again. The learners typically takes notes and try to pick up as many ideals and insights as they can from the expert during those class hours when the method in use. In Math classes extensive use of a blackboard during lecture is common.

To be effective the methods requires that the expert and the learners posses both background and skill sets. Among other things, the teacher should posses' mastery of his or her subject way beyond the details of the course, as well as skills of exposition and delivery –with-style. The learners must come to the class with a solid foundation in course pre-requisite and have the ability to concentrate for many minutes in a row. They must have the skill of effective note taking and be well organized:

Students learning research suggest that on entertaining lecture is not necessarily good teaching. Despite being entertained, students may not have learnt anything. Deep approaches to learning are more likely to be enhanced through a combination in the lecturer of explanatory skills

and certain communicative qualities. These qualities include the lecturer's ability to interact with students in ways which encourage involvement, commitment and interest (Bliss & Ogborn, 1977). Other ability to act from a student-centered position, to respect students and to provide individual guidance (Ramsden, 1988a)

There are just as many disadvantages to the lecture method as there are advantages.

Advantages of the Lecture Method

The lecture method has a few advantages that has kept it as standard approach to teaching mathematics for so long. Below is a list

1. **Teacher Control:** Because the lecture is delivered by one authoritative figure – a teacher, professor, or instructor of some other kind- that person has full reign of direction of the lesson and the tone of the classroom. They alone are able to shape the course, and so lecture remains highly consistent when it comes to what kind of information is delivered and how it's delivered.
2. **New Materials:** lecturers are literally just long-winded explanations of information, deemed important by the lecturers. As such, students can absorb large quantities of new material.
3. **Effortless:** The lecture method makes the learning process mostly effortless on the part of the students. Who need only pay attention during the lecture and take notes where they see fit? Because so little input is required from students, it's the most clear, straightforward, and uncomplicated way to expose students to a large quantities of information as explained above and in a way that is controlled and time sensitive. Students just need to know how to take good note.

Disadvantage of the Lecture Method

What's funny about the lecture method is many of the pros listed above could actually be seen as cons, as well, many don't see the nature of the lecture method as helpful in the least and this can be seen as explanations as to why listed below.

- I. **One way:** people who are against the lecture method see it as a one-way street, teachers dictates information to students, who have little to no opportunities to provide their own input, or protest the information being delivered. What if the teacher is wrong, or what if the students disagree with the teacher on a fundamental ideology in their lecture? Well, the student just have to sit down and take it, sometimes, the student will even be forced to agree with the lecture if they want a passing grade. If the lecture is on a sensitive topic, over which there is much conflicting discourse, you can imagine the problems this might cause.
- II. **Passive:** Not only do people see the lecture method as a biased, one-way road, but they also see it as a wholly passive experience for students. This isn't just harmful because of the ways described above. Not being actively engaged in a discussion over certain material can make the material itself seem worthless to a student. After all, the point of an education isn't to be programmed to think a certain way, according to your instructor's lectures, but to critically analyze the information being provided and learn how to apply it in different contexts. If a student has no place to opportunity, the course material with the person delivering the lecture, they will receive only a shallow understanding of the subject being discussed. Simply put, they might even be bored by the material because they will have no opportunity to learn how the subject applies to them on a personal level.

III. Strong Speaker Expectations: The lecture method can be disadvantageous to the teacher, as well. Not all academics can be expected to have the same level of public speaking skill, what if a teacher is a genius in his or her field, knows the materials from every angle, and is enthusiastic about the subject but has trouble speaking in front of large groups? The quality of a teacher's course should not suffer because they are unable to prepare a decent lecture. Just as being lectured to might not be the learning method of choice for many students. Being the one that is expected to do the lecturing might not be the best way for every instructor to present their course materials. But because the range of academic teaching methods are so limited, they are usually expected to do exactly that, potentially losing the elements of their lesson plan that makes it so strong.

The teacher in lecture method has a great responsibility to guide the thinking of the students and so he must make himself intelligible to them. Unlike other methods where motivations can come from subsequent activities, in the lecture students' interest depends largely on the teacher.

Comprehension by the class is the measure of success of the lecture to insure comprehension, two approaches may be used. The first is to have repetition or approach from another angle of thought. The second is to remove the causes of difficulty by using verbal and concrete illustrations.

Preparing the Teaching Lecture

Planning: The following five steps are followed in the planning phase of preparation:

- I. Establishing the objective and desired outcomes.
- II. Researching the subject;
- III. Organizing the material

IV. Planning productive activities

In all stages of preparing for the teaching lecture, the teacher should support any point to be covered with meaningful examples, comparison, statistics or testimony.

- I. Rehearsing: Teaching should rehearse the lecture to build self confidence.

Lecture method is based on three sources which makes it an effective tool teaching

- I. Schemata theory: it uses what students already know by building on their existing background.
- II. Meaningful verbal learning- presents information in a systematic way.
- III. Active learner involvement: uses teacher questioning to involve students actively in the learning process.

Application of lecture discussion method

Table 2.6: Nine events of instruction:

Instruction Event	Internal mental process.
Gain attention	Stimuli activates receptors
Inform learners of objectives	Creates level of expectation for learning
Stimulate recall or prior learning	Retrieval and activations of short – term memory.
Present the content	Selective perception of content
Provide learning guidance	Semantic encoding for storage long-term-memory
Elicit performance (practice)	Respondents to questions to enhance encoding and verification.
Provide feed back	Reinforcement and assignment of correct performance.
Assess performance	Retrieval and reinforcement of content as final evaluation
Enhance retention	Retrieval and generalization of learned skill to new situation

in spite of the strengths and weaknesses of traditional lecture format, along with several alternative approaches that encourages active students participation in course content, teacher need to determine their purposes and goals for presentation of course materials.

2.4 ACADEMIC PERFORMANCE IN MATHEMATICS

The word performance has to do with the resultant effect of a given task performance may be positive or negative. Dick (2009) opines that performance is the ability of a learners to excel in a given task. The outcome of an action whether in school or out of school situation speak for the result acquired. It is a process of assessing the worth of an action. Especially, in a school system, academic performance of learner is either good or bad.

Abagana (2011), says “performance is related to what a learner can do after he might have been taught”. The performance of a learner in school may be positive or negative. Positive performance means that the learner is doing or reporting well while on the other hand, negative performance implies that the learner is not reporting well.

It is common knowledge however, that performance of students in mathematics at the secondary school level in Nigeria is not encouraging despite the importance attached to it both as academic discipline and as knowledge that everybody needs in the society as stipulated by the National Policy on Education (FGN) (2004) in Nigeria.

2.5 ATTITUDE AND LEARNING OF MATHEMATICS

The word ‘attitude’ which is derived from the Latin word ‘aptus’ which means ‘fit and ready for action’. Attitude is indispensable in personality formation and manifestation and it is a core aspect in the study of human behaviour. Just like emotion, attitude have components which are related to beliefs, feelings and the tendencies to behave in a particular way, for instance, consider your Attitude when you are excelling, attitude determines the progress made by an individual, nation or even an organization.

The word “attitude” could mean different things to different people depending on the content of its utilization. This is due to cognitive, emotional and behavioural components (Boliner and Wanke, 2002, Bednar & Levie, 1993, Kamradt & Kamradt, 1999). The English Dictionary defines attitude as: a way of thinking (cognitive) or a posture of the body (emotional) or self confident or hostile behaviour (behavioural).

The definition of attitude towards mathematics is numerous as researchers’ conceptions, ideas and perspectives vary. According to a point of view, the attitude towards mathematics could be positive or negative emotional disposition towards mathematics (Zan & Martino, 2007). In other words, attitude towards mathematics is multidimensional; it could be viewed from its cognitive, emotional and behavioural components. Thus, attitude of individual towards mathematics could be viewed as the emotions that one associates with mathematics or the belief about mathematics or behavior towards the subject which could be either positive or negative (Hart, 1989). Research reports on attitude in mathematics education have revealed that attitude plays a crucial role in learning mathematics and connection between positive attitude and achievement in mathematics is inconclusive (Zan & Martino, 2007).

In the same vein, Allport (1955), as cited in Sokoya (2011) defined attitude as a mental state of readiness organized through experience exerting or directive or dynamic influence upon individual’s response to all objects and situations with which it is related. Attitude is an expression of how we like or dislike thing(s) or object(s). They represent our evaluations or preferences towards a wide variety of attitudinal objects. It is an enduring organization of motivation, emotional, perception and cognitive process with respect to some aspect of the individual’s world.

One of the earliest uses of the term ‘‘attitude’’ was from the theatre, this date back to the 1800s where it described posture or body position. The body position an actor assume on the stage such as dejection or elatedness was termed his mental state.

According to Green (1992), as cited in Sokoya (2011), attitude as a concept does not refer to any specific act or response but an abstraction from a large number of related acts or responses of the individual. He asserted that an attitude has three basic components:

- I. The cognitive component which represents thought or belief
- II. The affective and emotional component which reflects feelings or emotions
- III. The behavioral component which describes tendencies or predisposition towards certain activities based on a particular attitude.

Mathematics educators are still conducting research on how to improve student’s positive attitude towards mathematics for an improved academic performance. For instance, the National mathematics centre, (NMC, 2009), in Abuja attempted to revamp mathematics teaching and learning at the secondary school level researched into the causes and remedies for the abysmal failure of students in WAEC, SSCE and JAMB mathematics examinations. The centre discovered that poor performance in the promotion or public mathematics examinations has more to do with the teacher’s method of teaching than the contents of the curriculum of the school mathematics (NMC, 2009). It was against this empirical background that necessitated and spurred the center’s mathematics improvement program project (MIP) to create a new teaching methodology to enhance student’s attitude and performance in mathematics,.

Sarwar (2002) concluded that high academic achievers have better study habits and more positive attitude than low academic achievers. Shah (2002) explores that teacher’s attitude is one of the major factors affecting student’s learning.

It is evident that student's still low negative attitude towards the subject thereby leading to poor performance and low enrolment in the subject at higher level. Burstein (1992) in a comparative study of factors influencing mathematics achievement found that there is a direct link between student's attitude towards mathematics and student learning outcomes. He also found that 25% in England and 26% in Norway accounted for the variation in students' attitude towards mathematics that were due to student's gender material expectation, expectation from students' friends, and success attribution (belief about success in mathematics).

Students' belief and attitudes have the potential to either facilitate or inhibit learning. Students' attitude about value of learning mathematics may be considered as both an input and outcome variable because their attitude towards the subject can be related to educational achievement in ways that enforce higher or lower performance. This means that those students who have more positive attitude towards a subject tend to perform better the subject.

The question which comes to mind is what would be the likely sort of such attitude among student in senior secondary school in Kaduna state and what could be the reinforcing factors? Sources of negative or positive attitude may not be pin-pointed. Their source may overlap depending on an individual's learning environment. For the purpose of this research, the following were the identified likely reinforcing factors of attitude towards learning mathematics in the study area. In include:

1. Genetic Predisposition

Cockcroft (1982) refers briefly to theories indicating that different attitude could be as a result of genetic factor or hormonal influences of even differences in brain lateralization. Despite the report being credible, this assertion may not exactly be verified as to how a

student's exactly be verified as to how a student, either a girl or a boy may be pre-disposed to like something or dislike it. But Twoli (1986), cited case of documented differences in cognitive ability between girls and boys which in one way or another, the learner may form attitude towards learning particular subject. Orton (1987) agrees with the view that ability especially in mathematics is not innate, and he qualifies his assertion by stating that:

Mathematics abilities are not innate, but are properties acquired in life that are formed on the basis of certain inclination some have inborn characteristics in structure and functional features to the development of mathematics abilities anyone can become an ordinary mathematics, but one must be born an outstanding talented one (P.III).

While he is not completely dismissing the genetic factor, he agrees that other pertinent factor comes into play. It will be observed that there are students who do well in other subjects but not in mathematics some openly resisted leaning mathematics both in external and internal examinations. They have above average grades in other subject but perform low in mathematics.

Orton (1987) in his research indicates that males excelled in special ability whist females excelled in verbal ability. These differences may predispose the students to view mathematics learning differently. But (Ying et al, 1991) disagreed that the difference in ability may not necessarily be genetic but could be due to other factors.

However, perceived attitude of students towards success in mathematics affect the idea of mathematics as a subject. Teaching strategy such as problem solving can reduce totally the negative attitude towards mathematics by the student as in the view of Bolaji (2005) examined the influence of students' attitude towards mathematics and found that the

teachers' method of teaching and his personality greatly accounted for the students' positive attitude towards mathematics.

2. Societal Influence

Society is where the students grows and learnt from. It is common knowledge to hear people saying that they never passed mathematics no matter how they tried. This saying impact negative attitude of students towards mathematics. (Orton, 1994) attitude the noticeable difference in learning among boys and girls to ‘societal attitude and expectation’. He asserted that influences of society and from the environment affect mathematical development of students at various levels amongst boys and girls.

3. School Influence

Students spend more time in school than at home as they are expected to be in schools from Monday till Friday with only the public holiday off and during this time they are made to take extra lesson after the school hours. Much influence on a students learning could be in school given this much time spend there in while in school they are made to go through a planned school programme and curriculum.

New curriculum implementation and syllabus re-arrangement become a challenge to teachers to acquaint themselves and this impact negatively on how students learn mathematics while in class (Russel, 1983)

Hill and Rowe (1996) carried out a study on teacher attitude to their work and students' achievement in mathematics and found that substantial difference existed between teachers who had better attitude towards the subject and those who did not. They found out that it is primarily through quality of teaching that effective schools make s difference. Emenalo

(2000) remarked that since the teaching is carried out by the teacher while the achievement in mathematics concern the student (learner), it then becomes obvious that the attitude posed by the teacher in the teaching learning process would likely impact the achievement of the student. He noted that the attitude of teachers in the classroom could cause fear of the subject, which had claimed much causality over the years in internal and external examination in Nigeria.

These and many other factors could cause the negative attitude in mathematics at the senior secondary school in Kaduna State, Nigeria.

All these aspects contributing to formation are shown in figure 2.8.

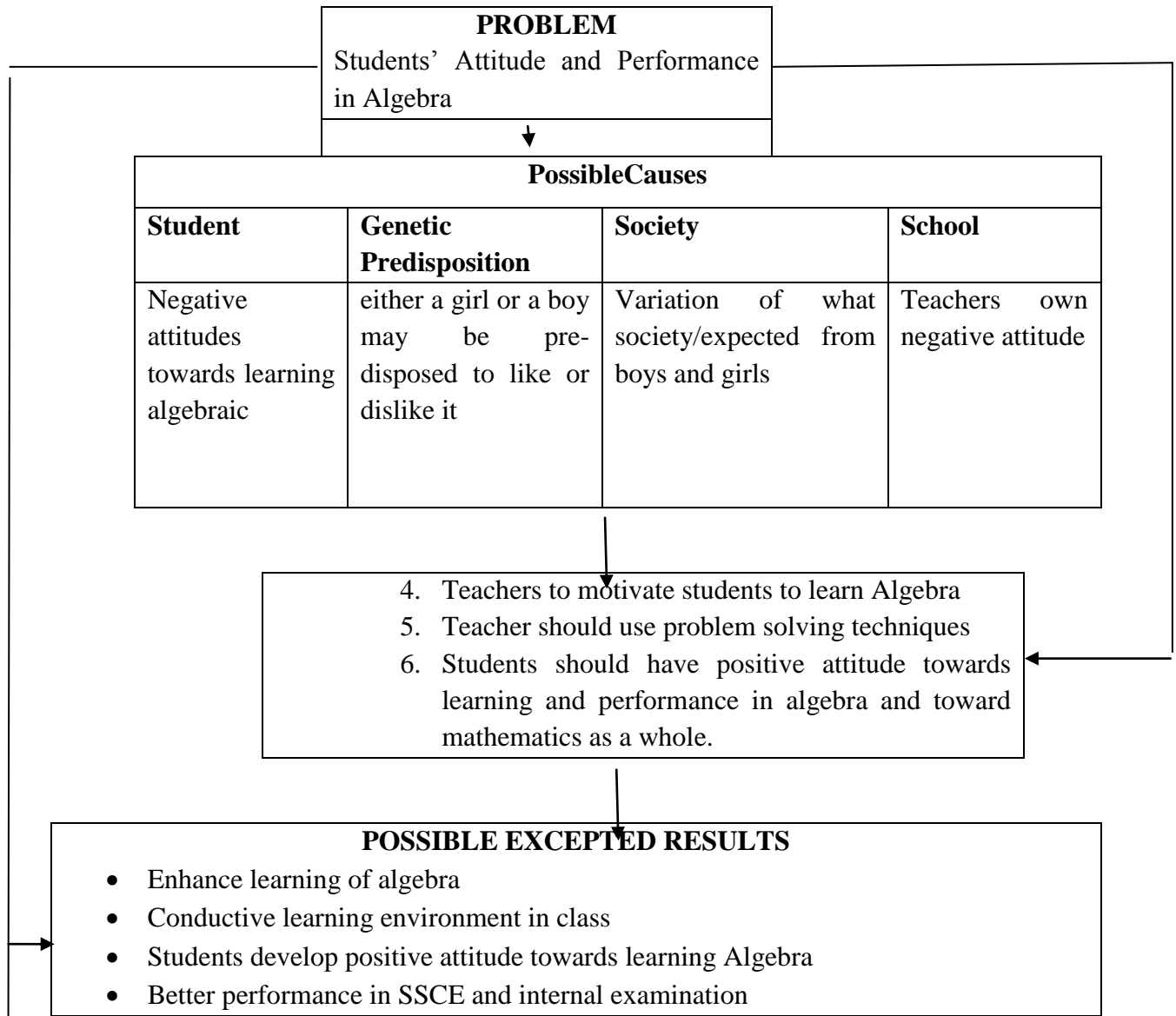


Fig 2.8: Conceptual frame work source: Adapted and codified from (Muntain 2010: 29).

2.6 GENDER AND PERFORMANCE IN MATHEMATICS AT SENIOR SECONDARY SCHOOL

Senior secondary is a level in Nigeria school system that student enters after the 3 year junior secondary school. According to the National Policy of Education (FGN) (2004). There is 6 year primary school years, 3 years junior secondary school, 3 year senior secondary school and 4 years A' level. This is what is all know as the ‘6, 3, 3, 4’ system of education.

Gender is a cultural construct that distinguishes the roles, behaviour, mental and emotional characteristics between females and males developed by a society. Umoh (2003) defines gender as a psychological term used in describing behaviours and attributes excepted of individuals on the basis of being born as either male or female.

According to Okeke (2003), the study of gender is not just mere identification of male and female sexes. Scholars have gone further to indentify responsibilities assigned to opposite sexes and to analyzes the conditions under which those responsibilities are assigned. Furthermore, Okeke (2003) specifically notes that the study of gender means the analysis of the relationship of men and women including the division of labour, access to resources and other factor which are determined by society as opposed to being determined by sex. It further involves the study of the socio-cultural environment under which responsibilities are assigned and relationship emanating from it.

It is obvious that every culture holds male superior to their female counterpart and this is evident and confirmed even in our society. Traditionally, sex role stereotyping and the differential valuation of male and female role have been viewed as an integral part of the socialization process and development of adult male and female potentials, male as naturally endowed have power and prestige thereby having higher and superior status than

women (Umoh, 2003). This illustrates the high level of gender stereotype in educational and the society at large.

Gender has being one major factors perceived to be influencing performance of student in mathematics, perhaps, the reason why males are pursuing mathematics related disciplines and professions than females.

However, the view by a cross-section of people that mathematics is a male dominated subject is devastating especially on part of women folk. At secondary school level, experience shows that girls deliberately or erroneously shy away from mathematics on flimsy excuse that their "head" are not made for mathematics (Aborisade, 2009). Gire (1988) stated that "the more a student believes that mathematics is a male or female domain the lower the performance will be" according to him, some people also feel that mathematics and science are of male students and that female students are destined to pursue languages and arts related subjects.

Gender differences in mathematics performance has been a great controversy issue in education domain and research documents show great discrepancies among girls and boys performance in school mathematics (Springler & Alsup (2003). Long research history in this area has shows that male advantage in mathematics achievement is a universal phenomenon (Jarson, 1996, Mullis et .al, 2000). While early research (Fennema & Sherman, 1977), indicated that males out performed female in mathematics achievement at junior high and high school level, there were also significant difference in attitudes towards mathematics between the two groups. Gallagher and Kaufman (2006), recognized that the math achievement and interest of boys are better than the girls. However, they explained that they don't know the main cause of these differences.

O'Connor – Petruso, Schiering, Hayes & Serrano (2004), have shown that gender differences in maths achievement become apparent at the secondary level when female students began to exhibit less confidence in their maths ability and performance lower than male on the problem solving and higher level mathematics tasks.

In spite of research evidence for male's superiority in math achievement, some research findings do not support the difference between two genders in math achievement. As an example, Springler & Alsup (2003), refer to researcher indication that shows no gender difference on mathematical reasoning ability at elementary. Finding from longitudinal study about gender difference in mathematics shows that there is no difference among boys and girls in mathematics achievement. (Ding, Song and Richardson; 2007). This study shows that growth trend in mathematics among two genders was equivalent during the study times. According to a recent international study conducted by IEA, on average across all countries, there was essentially no difference in achievement between boys and girls at either the eight or fourth grade (Mullies et al, 2004).

Over the last three decades, diverse theories and frameworks have been developed and many have tried to identify factors that influence math performance in senior secondary schools in order to reduce gender inequality in math achievement (O'Connor-Petruso & Miranda, 2004). Research evidence shows that gender difference in mathematics achievement are due to various factors such as biological factor (Geary et al, 2000), mathematics learning strategies (Carr & Jessup, 1997), sex hormones on brain organization (Kimura, 2002) and Symbolic gender (Nielsen, 2003).

Research finding shows that students performance in mathematics are due to factors such as attitude toward mathematics (Hammouri, 2004; Kiamanesh, 2004), self concept (Bryen and Shavelson, 1987, Campbell, Connolly and Pizzo, 1986) home environment (Weisse &

Krappmann, 1993; Fullarton, 2004; Kourt Soulis & Campbell; 2001, Howi, 2005). Parental education (Beane & Likpa, 1986; Alomar, 2006). School climate and culture (Fullan, 2001), and school connectedness or engagement (Blum & Libbey, 2004). Several studies have revealed that the educational level of students' parent (Beaton et al, 2000), socioeconomic status of the family (Marjorbanks, 2002), home language verses, language of test (Howie, 2002) and providing quality homework assistance by parents (Engheta, 2004), are among factors that can explain variance in academic achievement.

Home is the backbone of children's personality development, and influences both directly and indirectly through the kind of relationship the family members have among themselves as well as through helping them to get in contact with the society (Weiss & Krappmann, 1993). Fullarton (2004), indicates that "at student level, home background index.....is a strong predictor of achievement in mathematics (P-24).

The relationship between mathematics self-concept and math achievement is an area that has been investigated by researcher (Marsh, 1993; Hamachek, 1995). Low self-concept tend to appear together with students' underachievement. Most findings in this area showed that those who are higher self-concept i.e. having more confidence in math, gain higher scores in mathematics (Wilhites, 1990).

Students who know their teacher care about them and have been had clear and reasonable expectation, can get better score (House, 2005). Supportive teacher play a significant role in student's engagement in school (House, 2005). School's climate and culture (Fullan, 2001). Although, many factors inside and outside of school influence students' level of achievement , the quality of teaching is important for improving students' learning (Hammnouri, 2004, Antonijevic, 2005). Does all these factors above affects the

performance of senior secondary school in Kaduna State? This research will investigate and find out.

2.6.1 GENDER AND ATTITUDE TOWARDS MATHEMATICS

Attitudes are affective variable of paramount importance for the well being of the individuals and the society. Individual have to acquire the right types of attitudes towards self, work, other people and object. There has always been an interest in the development of positive students' attitude towards mathematics. The objectives of teaching and learning mathematics include fostering favorable feelings towards mathematics as well as imparting cognitive knowledge. Foster (1984) mentions the fact that large gender difference do exist with respect to attitude towards mathematics.

Attitude is a central part of human identity. Every day, people love, hate, like, dislikes, favour, oppose, agree, disagree, argue, persuade etc. However, there are many studies that there is no significance difference between attitude towards mathematics among male and female students (Mohd et al, 2011; Kogce et al, 2009; Nicolliadou & Philoppou, 2003), And there are some other studies which suggest that the attitude of the participants of their study towards mathematics was more positive in the third year than the first year.

Studies on attitude towards learning of mathematics and achievement in the subject indicates that attitude play a major role in student's effort to learn. Attitude formed could genetically be predisposed (Orton, 1987), or being influenced by societal exceptions (Macnab & Cummine, 1986) especially parents (Ying, 1991), as a result of unconscious reinforcement by the teachers (Russell, 1983), or could be as a product of student-student or teacher-student interaction while in school (Costello, 1991). These could be positive or negative towards learning of mathematics at the senior secondary school level. Whatever nature of attitudes formed by the students, they may determine their confidence in learning

mathematics and may also help them perceive the usefulness of mathematics hence enjoy mathematics as they learn (Fennema & Sherman; 1976). It becomes even more difficult to describe clearly the connection between attitudes and achievement in mathematics. But attitude can lead one to learn less mathematics and consequently achieve low in both internal and external examination such as WAEC, NECO and JAMB.

Most of these studies show that there is positive correlation between students attitude towards mathematics and academic achievement of students (Mohd et al, 2011; Branmlet & Herron, 2009; Papanastasiou, 2000, Ma & Kishor, 1997).

Although, many factors inside and outside the school influence students attitude towards mathematics. According to Butty (2001), instructional practices have impact on mathematics achievement as well as attitude towards mathematics. Some research findings indicate that instructional practice has positive effect on students' mathematics achievement and attitude towards mathematics (Butty, 2001).

Students' beliefs and attitudes have the potential to either facilitate or inhibit learning. Students attitudes about the value of learning mathematics may be considered as both an input and output variable because their attitude towards the subject can be related to educational achievement in ways that enforce higher or lower performance. This means that those students who have more positive attitude towards mathematics tend to perform better in the subject.

Overview of Similar Studies

A number of researches have worked on empirical studies on the effect of two or more instructional strategies on students learning outcome. A lot of these researches were truly provoked and prompted by factors related to poor students learning outcomes (performance, achievement, attitude, problem-solving

performance, retention etc) in their study field. So many things were advanced to have been affecting the students' problem-solving ability but all such things as teacher approaches (problem-solving method), conceptual understanding of the subject, problem-solving skills possessed by problem solver, relevant knowledge of basic scientific definition and principle that exist in the problem solvers mind. Research reports on attitude in mathematics education have revealed that attitude plays a crucial role in learning mathematics and connection between positive attitude and achievement in mathematics is inclusive (Zain & Martino, 2007). Research findings have shown that students' poor performances in mathematics are due to factors such as attitude towards mathematics (Hammouri, 2004; Kiamanesh, 2004).

According to Butty (2001), instructional practices have impact on mathematics achievement as well as attitude towards mathematics. Some research findings indicated that instructional practices have positive effect on students' mathematics achievement and attitude towards mathematics. For instance, Usman & Akor –Ebuta (2006) carried out a study entitled Enhancement of students 'achievement and interest in geometry using Polya's problem-solving model. The sample consisted of 214 SSII students drawn from two secondary schools. Two instruments, Geometry Achievement Test (GAT) and Geometry Interest Scale (GIS) were used to collect data for the study. Data were analyzed using Analysis of Covariance (ANCOVA) and independent t-test statistics. Two hypotheses were tested at 0.05 alpha levels. The study adopted a quasi-experimental design, since experimental and control groups were used for the study. A total of 241 students were involved in the study with experimental

group having (55 boys and 61 girls). The result of result of the analysis showed that Polya's Problem-Solving approach to mathematics instruction enhanced students achievement in geometry than the conventional approach to mathematics instruction. It was also, discovered from the results of the study that there was no significant difference in interest between students taught with Polya's Problem –Solving approach and those taught with the conventional approach. In another study Samuel (2013) investigated the effect of George's Polya Problem Method on Students' Achievement and Retention in Algebra. The sample consisted of 220 SSII students from Ishielu Local Government Area of Ebonyi State. Quasi-experimental design was adopted in the study. Four hypotheses were tested at 0.05 alpha levels. Algebra Achievement Test (ALAT) was used for data collection. Data collected were analyzed using Analysis of Covariance (ANCOVA). The findings of the study revealed that students taught Algebra with Polya George's Problem-Solving Model (POGPROSMO) achieved higher and retained more than those taught with conventional method. However, there were no significant achievement and retention scores of male and female students in the study.

Furthermore, Emenalo (2000) noted that the attitude of teachers in the classroom could cause fear of mathematics subject, which had claimed many causalities over the years in internal and external examinations in Nigeria. These and many other factors could cause the negative attitude in mathematics at Senior Secondary School in Kaduna State, Nigeria. Therefore, this study seeks to find out The effect of Problem-Solving Strategy on Attitude and Performance in Algebra among Senior Secondary School Students in Kaduna State, Nigeria.

2.7 IMPLICATION OF LITERATURE REVIEW ON THE STUDIES

The literature reviewed to this current study would be of immense value in quite a number of ways:

- I. It will serve as a point of focus to the current study.
- II. It will reveal the areas covered and the area left uncovered. This will further guide the researcher to learn how to cover the area yet uncovered.
- III. It would enhance the strength of instrument for data collection and choice of research design to the current study.
- IV. It will give an opportunity to the researcher to compare the result of previous works in relation to the current study.
- V. The findings and recommendations of the previous studies will greatly improve the current study.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 INTRODUCTION

This study was designed to investigate the effect of problem-solving instructional method on attitude and performance in Algebra among senior secondary school students in Kaduna State, Nigeria. In this chapter the researcher explained the methodology used in carrying out the investigation. The chapter is presented in the following sub-headings:-

- 3.2 Research designs
- 3.3 Variables
- 3.4 Population of the Study
- 3.5 Sample and Sampling Technique
- 3.6 Instrumentation
 - 3.6.1 Development of ATQ
- 3.7 Pilot Testing
 - 3.7.1 Validation and Reliability of ATQ
 - 3.7.2 Lesson Plan
- 3.8 Data Collection Procedure
- 3.9 Administration of Treatment Procedure
- 3.10 Data Analysis Technique.

3.2 RESEARCH DESIGN

This study adopted the quasi experimental design, involving pre and post tests as suggested by Kerlinger, (1973). The design was adopted because it was not possible to have a complete randomization of the subjects as this will disrupt school organization. In this design, the researcher used experimental and control group to determine the effect of problem solving strategy on attitude and performance in Algebra among senior secondary school students in Kaduna state, Nigeria. This design is appropriate because according to Osuala (2005), experimental design helps to derive, verified functional relationship among phenomena under controlled condition. The instructional strategy is at two levels. (Experimental and control groups), the experimental group received Algebra lesson instruction through problem solving method. While the control group, were taught the same lesson using conventional teaching method. The research design is illustrated in figure 3.1 below

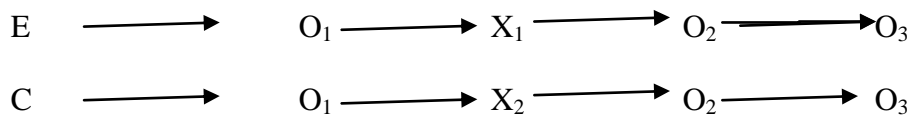


Fig 3.1: Illustration of research design

The symbols are denoted as follows

E = Experimental Group (PSM group)

C = Control group

X₁ = Treatment Using PSM

X₂ = Treatment Using CTM

O₁ = Pretest

O₂ = Post Test.

O₃ = Algebraic Retention Test (ART)

3.3 POPULATION OF THE STUDY

The population of this study consists of senior secondary school students of public schools within the study area. Private schools and unity school (Federal Government Schools) within the study area are not part of the study. The population of the study involves both mathematics students in urban and rural area. According to the population of students of public school within the study area at the time of this study was two thousand four hundred (2,400). All the schools used are government owned schools, with a mean age of 16 years old students, with same curriculum, syllabus, time-table and calendar for study.

Table 3.3 Population of the study and their education zone within the study area.

S/N	Zone	Number of school	Students
1.	Zaria	43	152
2.	Kaduna	35	189
3.	Rigachikun	30	93
4.	Anchau	63	238
5.	Giwa	33	101
6.	Birnin Gwari	20	132
7.	Sabo Tasha	65	375
8.	Kachia	56	94
9.	Zonkwa	46	84
10.	Lere	43	97
11.	Gwdo- Gwdo	36	186
12.	Kafanchan	49	159
13.	Total	489	2400

Source: Ministry of Education M.O.E Kaduna State.

3.4 SAMPLE AND SAMPLING TECHNIQUE

Simple random sampling technique involving ‘balloting method’ was used to select the sample of the study from the population of SS II students of eight different schools in Kaduna state. The rationale for choosing this design was to ensure that the academic programmes of the school was not disrupted, and also, for the convenience of the researcher. Students for experimental group consist of one girls’ school in the urban and one girls’ school in the rural area also one boys’ school in the urban and one boys’ school in the rural. The total number of schools selected for the experimental group was four. The four groups were taught topic in Algebraic using problem solving method for ten (10) weeks (ten lessons), while the control group were taught using conventional method. They also consist of four groups. The total number of students involved in this research from the eight different schools in Kaduna State is 238 (experimental group urban girls), 35 (experimental group rural girls), 43 (experimental group urban boys), 40 (experimental group rural boys), while 20 each for control group. The number of the study subject was considered based on the population of each of the selected schools. This figure 238 was viable for the study as it was in line with the Central Limit Theory table of determining sample size for research activities and Sambo (2008) who recommended that sample size of minimum 30 is viable for experimental study of this nature. Table 3.4 shows the summary of this information.

Table 3.4 Sample of the Study

Educational Zone	Name of school	Gender		Location		Method of teaching
		M	F	U	R	
Zaria	GGSS Gyallesu	-	40	40	-	PS
	GGSS Soba	-	35	-	35	PS
	Alhuda-Huda College	43	-	43		PS
	GGSS Dinya	40	-	-	40	PS
Kaduna	GGSS Kawo	-	20	20	-	CM
Giwa	GGSS Giwa	-	20	-	20	CM
	GSS Tabo Sani	20	-	-	20	CM
Rigachikun	GSS N/ Rihachikun	20	-	20	-	CM
Sub-total		123	115	123	115	
Total sample of students		238		238		

3.5: INSTRUMENTATION

Basically, the instrument used for the study was:

- i. Algebraic Attitude Test (AAT)
- ii. Algebraic Test Question (ATQ)
- iii. Algebraic Retention Test (ART)

The students' Algebraic Attitude Test (AAT) was made up of two (2) sections A and B section A seeks for students' Bio-data such as name of school, class, and sex. While section B contained forty (40) of four (4) responses Likert Scale of Strongly Agree (A,4), Agree (A, 3), Disagree (D, 2) and Strongly Disagree (SD, 1).AAT was used to obtained data from mathematics students in senior secondary in Kaduna state. The data were consequently used to identify attitudes formed by these students towards learning and performance in Algebra. ATQ using problem solving was used to determine the effect of problem solving

on performance of these students and ART was used to determine student's retention in Algebra

Algebra Test Question (ATQ) contained two (2) sections A and B. section A as usual seeks for the students Bio-data , while section B consisted of 50 item multiple choices type based on senior secondary two mathematics curriculum on algebra. The multiple choice items have four (4) options A-D which included one correct answer and four distracters from which to select one right option.

The Algebraic Retention Test (ART) is just a carbon copy of the ATQ as it contained the same number of sections and items. This instrument was used to determine the extent of students' retention ability level in algebra after treatment.

Table 3.5 Table of specification

Topic	Knowledge	Comprehe nston	Application	Total	Number of Questions
Algebraic Process	3	3	4	10	5(1-5)
Algebraic Equation	4	2	4	10	5(6-10)
Indices	2	3	5	10	5(11-15)
Logarithms	3	4	3	10	5(16-20)
Surds	3	4	3	10	5(21-25)
Sequence and Finite Series	2	3	5	10	5(26-30)
Polynomials	3	3	4	10	5(31-35)
Change of Subjects and Variation	3	2	5	10	5(36-40)
Inequalities and graph function	3	3	4	10	5(41-45)
Graph and Gradient of Straight Line	3	3	4	10	5(46-50)
Total	29	29	42	100	50

3.6 DEVELOPMENT OF ALGEBRAIC TEST QUESTION (ATQ)

40 questions were drafted for pilot testing by the researcher, out of which 30 questions were selected to form an Algebraic Test Questions (ATQ). The test was to cover the

Algebraic topics in the SSS from the curriculum by NERDC. The test was a multiple choice objectives with 4-alternative for each questions. It was first trial tested on SS II students of Federal Government College, Kaduna who were not involved in the main study, but uses the same syllabus (curriculum). The test items were reviewed, edited and amended for use in the research. Questions that received more scores and those that were woefully failed were streak out. The moderated questions were then used to conduct the research. AAT was a forty item Likert Scale instrument with two sections A and B constructed by the researcher which was administered to both the experimental and control groups prior to the commencement of the treatment as well as after the treatment to identify attitudes formed by these students towards learning and performance in Algebra. The ART contained two sections A and B. Section A sought for the Bio-data of the students while section B was made up of 50 item multiple choice type based on senior secondary two mathematics curriculum on algebra. All the instruments were developed to cover lower and higher order algebra questions.

3.7 RELIABILITY OF INSTRUMENT

Note: for the purpose of pilot study a total of 40 students were randomly selected from four secondary schools which are Federal college Kaduna, Royal secondary school Kurmin Mashi Kaduna and Penfield Science secondary school Kaduna. These schools are chosen as they are not within the selected schools for the main study, but share similar characteristics in all respects. The reliability of instrument using PPMC test re test is 0.89 . This reliability coefficient was considered reliable for the main study. This was a confirmation of test of reliability by Spiegel (1992). and Stevens(1986), and Olayiwola, (2010).According to them an instrument is considered reliable if it lies between 0 and 1, and that the closer the calculated reliability coefficient is to zero, the less reliable is the

instrument, and the closer the calculated reliability co-efficient is to 1, the more reliable is the instrument. This therefore confirms the reliability of the data collection instrument used as fit for the main work.

3.7: Pilot Testing

The algebraic test question was subjected to a pilot study prior to the actual study. The pilot study was conducted on (3) schools within the 12 educational schools in Kaduna state. Thirty (30) students were used as participants for the pilot study. The schools are: Federal Government College, Kaduna, Royal Secondary School, Kurmi-Mashi, Kaduna and Penfield Science Secondary School, Kaduna.

The test was conducted to the participants to supply answer after which they were collected. After a period of two weeks, the tests were administered again to the same students to answer. The test items were split into two halves, the odd number items and the even number items. The results obtained were analyzed using Pearson Product Moment Correlation (PPMC) was used and obtain 0.89 appendix. C

3.7.1: Validation and Reliability of ATQ

A committee of four experts moderated the frames of the ATQ. The content of the ATQ was checked and validated by 5 experienced mathematics teachers. This involved looking into the consistency between the test and the content of the study topics. Their corrections, recommendations and comments were taken into consideration for the final draft of the test items.

The reliability determination of the instrument was carried out using cronbach alpha method which was found to be 0.89 for (ATQ). This showed that the instrument was reliable and could be used for the study. Initially, AAT contained 70 multiple choice item. The corrections and suggestions of the experts reduced it to a 50 multiple choice items.

3.7.2: Lesson Plan

Lesson plan was developed by the researcher to cover ten (10) lessons, ten topics for 10 weeks of teaching. The topics for the lessons were broken down into achievable behavioural objectives. Table 3.5 provides this information. The lesson plans were constructed for problem solving method and conventional method. Both lesson plans were given to experienced teachers and specialist in mathematics education for validation. They were requested to ascertain the following:

- I. The procedure to be adequate for teaching steps and strategies of problem solving.
- II. Relevance of student's activities and evaluation question for the lessons.
- III. The content and appropriateness of the lesson objectives for the lesson.

Their suggestions, correction and comment were used for the final draft of the lesson plans.

Table 3.6: SSS Algebra Syllabus

Contents	Objectives
1. Algebraic processes	<ul style="list-style-type: none">• Use letters to express number• Express basic arithmetic processes algebraically• Substitute numbers for words and letter in formulae• Use brackets and extract common factors and• Expand and factorize algebraic expression
2. Algebraic Equations	<ul style="list-style-type: none">• Solve simple linear equations• Solve simultaneous equations• Solve quadratic equation using different available methods including graph.• Solve word problems leading to simultaneous linear equations and• Solve problems leading to quadratic equations.
3. Indices	<ul style="list-style-type: none">• State and use the laws of indices in calculations• Use the relationships between indices and numbers to solve exponential equations.

4. Logarithms	<ul style="list-style-type: none"> • State and use the laws of logarithms in calculations. • Use the relationship between indices and logarithms to solve problems. • Use logarithm tables in calculations.
5. Surds	<ul style="list-style-type: none"> • Simplify surds. • Rationalize demoninator of fractional surds. • Carry out operations involving surds.
6. Sequence and finite series	<ul style="list-style-type: none"> • Identify a sequence. • Find the nth tem of sequence • Find the sum of finite series. • Solve problems on sequence and finite series.
7. Polynomials	<ul style="list-style-type: none"> • Identify a polynomial. • Manipulate a polynomial under the operation, subtraction, multiplication and division. • Factorize polynomial of degree than or equal to four • Find roots of polynomial equations using the factors theorem • Solve polynomial equation by graphs.
8 change of Subject and Variations	<ul style="list-style-type: none"> • change the subject of formulae • solve problems on change of subject • use the knowledge of change of subject to solve problems involving variations, solve problems on inequalities in variable
9. Inequalities and graphs (functions)	<ul style="list-style-type: none"> • Solve problems on inequalities in one variable. • Represent solution sets on a number line. • Solve problems on linear inequalities in two variables. • Apply inequalities to linear programming.
10, straight – line graphs and gradients of straight line	<ul style="list-style-type: none"> • Calculate the gradients of a straight line from the coordinates of two points • Calculate the length of a straight line segment from the coordinate of its end points • Calculate the coordinate of the midpoint of a line segment. • Obtain the equation of straight line in the form $y = mx + c$

Source: NERDC (2015)

3.8 DATA COLLECTION PROCEDURE

Data collection was done in the sample schools. The researchers visited the sampled schools first to familiarize with the school authority and explain the purpose of the study and secondly make necessary arrangement for data administration of the instruments and data collection. The procedures used for data collection are as follows:

- Pretest
- Treatment
- Post- test

Pretest

This is the initial stage where the instrument is administered to the four groups which involve both the experimental group and control group. The result is computed and analyzed in Appendix ix

Treatment

The treatment for this research work took the maximum of 10 weeks where there were 10 contact lessons with both the experimental groups and the control groups. The experimental groups were taught using the problem solving technique whereas the control group were taught using the normal convectional method of teaching mathematics. The content of the instrument is same for both (experimental and control). The lesson was taught by the researcher and the help of research assistant i.e the students regular teachers. The syllabus used for these lessons is same with other schools (NERDC).

Post Test

The post test was carried out after the pretest and treatment. The post test include both questions (AAT and ATQ)

3.9 ADMINISTRATION OF THE TREATMENT PROCEDURE

A research permit was sought from the faculty of education to enable the researcher use it while trying to obtain data for the study. This permit was presented at ERC, NECO, WAEC, Kaduna Ministry of Education and the schools. Once in the schools, permission was also sought from the respective school principals before administrating the instrument.

The treatment took 10weeks of 10 lesson and 10 topics. Each period was for 40 minutes but it was double periods throughout, which was 80 minutes.

The three tests each conducted carried 100 marks. Each test contains 50 items of 2 marks each. The test was marked, compiled and analyzed.

3.10 DATA ANALYSIS

Data collected were analyzed by the use of descriptive and inferential statistics. The Data collected from the instruments were coded and entered in to the computer. The research questions were answered using descriptive statistics of mean and standard deviations as the data was in the form of nominal data scale while, the research hypotheses were tested using inferential statistics of t-test statistic as the data was in the form of interval data state. All the hypotheses and were tested at 0.05 alpha level of significance.

CHAPTER FOUR

DATA ANALYSIS: PRESENTATION AND DISCUSSIONS OF RESULTS.

4.1 Introduction:

This study was primarily aimed at assessing the effect of problem solving method in the academic performance of algebra of mathematics students and to establish the effect of attitude on their performance. A total of 238 students consisting of experimental and control students were used. Items on attitude were analyzed using the descriptive statistics of frequency and means. The first section presents the distribution of respondents by their demographic variables in frequencies and percentages. These include their treatment groups of gender and the school locations. A total of five research questions were answered using the descriptive statistics of means, standard deviations and standard errors of means. The third section tested five research null hypotheses using the inferential statistics of t-test statistics, all the hypotheses were tested at 0.05 alpha level of significance.

4.2 Data Presentation:

The data used for this study were summarized in tables below.

Table 4.01; **Distribution of Bio Data Variables by Groups**

Variables	Frequency	Percentage
Problem solving (Experimental)	158	66.4
Conventional (Control)	80	33.6
Total	238	100.0

The students were categorized mainly into two treatment groups. The first group is the experimental group consisting of 158 students representing 66.4% that were taught algebra

using the problem solving method, and the rest 80 students representing 33.6% were the control students that were taught algebra using the conventional method.

Table 4.02; **Distribution of Bio Data Variables by Gender**

Variables	Frequency	Percentage
Male	82	51.7
Female	76	48.3
Total	158	100.0

The outcome of the table above showed the distribution of respondents by their sex. it showed that a total of 123 representing 51.7% are males and the rest 115 representing 48.3% are female students

Table 4.03; **Distribution of Bio Data Variables by school Location**

Variables	Frequency	Percentage
Urban	84	52.9
Rural	74	47.1
Total	158	100.0

According to the table above a total of 126 representing 52.9% are urban students and the rest 112 representing 47.1% are students from rural locations

Algebraic Attitudinal Test (AAT)

Table 4.4: Perception of responses on effect of attitude towards the learning performance of algebra in Mathematics

S/NO	Items	Response categories				Mean	Decision
		SA(4)	A(3)	D(2)	SD(1)		
1	students have positive attitude towards the learning of mathematics especially algebra	54	71	71	42	3	Agreed
2	I believe my math's teacher teach the subject of algebra effectively	88	55	47	48	3	Agreed
3	I look forward to the math algebra lesson	87	65	61	25	3	Agreed
4	I like the giving of relevant and adequate assignments on the issues taught	71	69	49	49	3	Agreed
5	I consider the mathematics teacher to have the subject mastery	74	73	62	29	3	Agreed
	Cumulative mean					3	Agreed

Decision mean = 3

The table above showed the responses of students' attitude towards the learning of algebra in secondary schools. According to the table the students believe that attitude has positive effect on the learning of algebra. This is because the cumulative mean response on all the items was 2.7462 which were found to be higher than the decision mean of 2.50000. specifically majority look forward to the math's algebra lesson as this item attracted the highest mean of 2.8992 with details showing that a total of 87 strongly agree while 65 were in agreement as against 61 that disagreed and the rest 25 in strong disagreement.

In the same vein, most of them consider the mathematics teacher to have the subject mastery, as this item attracted the second highest mean of 2.8067 with details showing that

while 74 were in strong agreement, 73 were in agreement as against 62 that disagreed and the rest 29 in strong disagreement. In summary it is believed that attitude towards algebra has effect on the performance of students, specifically the mastery of the mathematics teachers and the eagerness of students to mathematics lesson

4.3 Data Analyses:

4.3.1 Establishing Homogeneity of the Groups

In order to show that both experimental and control groups were all drawn from equal ability level students, Table 4.05 gives a descriptive statistics of pre-test performance for the two groups.

Table 4.05 Descriptive statistics on the effect of problem solving method on the mean academic performance of students in algebra

Variables	Groups	N	Mean	Standard dev.
Pre test	Experimental	158	18.41	3.32
	Control	80	18.42	3.31
Post test	Experimental	158	22.24	3.81
	Control	80	18.46	3.33

Table 4.5 revealed the performance of the experimental and control groups prior to treatment. Experimental group (M=18.14, SD=3.32) and that of Control group (M=18.41, SD=3.32). This shows that the students were on the same academic ability before the treatment as the mean performance were all within a close range of 18.41 to 18.46.

Table 4.06: Relationship between the performance of students and their attitude towards algebra

VARIABLES	N	MEAN	S.D	CORRELATION INDEX R
PERFORMANCE	238	20.97	4.07	0.63
ATTITUDE	238	13.73	3.07	

Table 4.06 showed the relationship existing between the performance of students and their attitude towards algebra. Performance ($M=20.97$, $SD=4.07$) and Attitude ($M=13.73$, $SD=3.07$). This shows that the attitude of students towards algebra has significant relationship on their performance. This implies that the higher the students level of positive attitude the higher their performance in algebra and vice versa.

4.3.2 Answer to Research Questions:

The questions propounded for study were answered using descriptive statistics as follows

Research Question One: What is the difference between attitude of student taught Algebra with problem solving strategy (EG) and those taught with conventional method (CG)?

Table 4.07: Descriptive statistics for differences in attitude of students who were taught algebra using problem solving technique and those taught using conventional lecture method

Variables	N	Mean	std.dev	Remarks
Problem solving method (Exp)	158	14.13	3.06	Students taught algebra with problem solving method perform higher than those taught with conventional method
Conventional (Control)	80	13.73	3.02	

Table 4.07 revealed the differences in attitude of students who were taught algebra using problem solving technique and those taught using conventional method as Experimental group ($M=14.13$, $SD=3.06$) and Control group ($M=13.73$ $SD=3.02$). This implies that students taught algebra with problem solving method had positive difference in attitudinal mean score than those taught with conventional method.

Research Question Two: What is the difference between performance of student taught Algebra with problem solving strategy (EG) and those taught with conventional method (CG)?

Table 4.08: Descriptive statistics for differences in performance of students who were taught algebra using problem solving technique and that taught using conventional lecture method

Variable	N	Mean	std.dev	std.err	Remarks
Problem solving method (Exp)	158	22.24	3.81	0.30	Students taught algebra with problem solving method perform higher than those taught with conventional method
Conventional (Control)	80	18.46	3.33	0.37	

Table .08 revealed the descriptive statistics for difference in performance between the experimental group and control group students who were taught algebra using problem solving technique and those taught using conventional lecture method. Experimental group (M=22.24, SD=3.81) and Control group (M=18.46, SD=3.33).. This implies that students taught algebra with problem solving method performed higher than those taught with conventional method,

Research Question Three: Do Male and Female students taught Algebra with problem solving strategy (EG) differs in attitude?

Table 4.09: Descriptive statistics for differences in attitude of male and female students who were taught algebra using problem solving technique

Gender	N	Mean	std.dev	Mean Difference
Male	82	13.78	3.12	0.35
Female	76	13.43	3.42	

Results of the descriptive statistics in Table 4.0 9 revealed the differences in attitude of male and female students who were taught algebra using problem solving technique. Male students (M=13.78, SD=3.12) and Female students (M=13.43, SD=3.42). This clearly showed that gender does not influence attitude towards on or before treatment with problem solving strategy for teaching algebra.

Research Question Four: Do Male and Female students taught Algebra with problem solving strategy (EG) differs in performance?

Table 4.10: Descriptive statistics for differences in performance of male and female students who were taught algebra using problem solving technique

Gender	N	Mean	Std. Dev	Mean Difference
Male	82	22.03	3.79	0.45
Female	76	22.48	3.84	

Table 4.10 showed the descriptive statistics for the differences in performance of male and female students who were taught algebra using problem solving technique as: Male (M=22.03 SD=3.79) and Female (M=22.48 SD=3.84). The performance of male and female students after treatment showed only a slight difference of 0.45 in favour of the female students.

Research Question Five: Do students from Urban and Rural areas taught Algebra with problem solving strategy (EG) differs in performance?

Table 4.11: `Descriptive statistics between urban and rural school students in their performance in algebra after Treatment

Location	N	Mean	Std. Dev	Mean Difference
Urban	84	21.13	4.09	0.33
Rural	74	20.80	4.05	

Table 4.11 showed the descriptive statistics between urban and rural school students' performance in algebra after treatment as: Urban (M=21.13, SD= 4.09) and Rural (M=17.80 SD=3.09). This implies that students' performance in algebra is not affected by their school locations.

4.3.3 Test of Null Hypotheses:

The following research hypotheses were formulated based on the research questions raised and are tested at 5% level of significance.

Null Hypothesis One

HO₁: There is no significant difference between attitude of student taught Algebra with problem solving strategy (EG) and those taught with conventional method (CG).

To test the first null hypothesis, independent sample t-test table 4.12 below was used as the data for attitude was converted to parametric data through the use of Likert scale.

Table 4.12: `Independent Sample t-test Statistics for difference in Attitude between Experimental and Control groups

Variable	N	Mean	std.dev	df	T	P
Problem solving method (Exp)	158	14.13	3.06	236	2.05	0.001
Conventional (Control)	80	13.73	3.02			

p≤0.005 level of significance

The result in Table 4.12 of the independent sample t-test statistics revealed that difference in attitude test scores of students exposed to the treatment of problem solving strategy when compared with those exposed to only the conventional method between the experimental group (n= 158, = 14.13, SD =3.06) and control group (n = 80, M = 13.73, SD = 3.02) was statistically significant, $t(c) = 2.05$, 95%, $df = 236$.

This shows that there was a significant effect of problem solving method on the attitude of students taught algebra by means of problem solving. Consequently, the null hypothesis which state that there is no significant difference between attitude of student taught Algebra with problem solving strategy (EG) and those taught with conventional method (CG) is hereby rejected.

Null Hypothesis Two

HO₂: There is no significant difference between performance of student taught Algebra with problem solving strategy (EG) and those taught with conventional method (CG).

Table 4.13: Independent Sample t-test Statistics for difference in Performance between Experimental and Control groups

Variable	N	Mean	std.dev	Df	T	P
Problem solving method (Exp)	158	22.24	3.81	236	2.02	0.000
Conventional (Control)	80	18.46	3.33			

$p \leq 0.005$ level of significance

Table 4.13 showed the results of the independent sample t-test statistics that the difference in test scores between the experimental group (n=158, M= 22.24, SD = 3.81) and the control group (n = 80, M = 18.46, SD = 3.33) was statistically significant $t(c) = 2.02$, $P = 0.00$, 95%, $df = 236$. This showed that there was a significant effect of problem solving method on the performance of students taught algebra using problem solving.

Consequently, the null hypothesis which state that there is no significant difference between performance of student taught Algebra with problem solving strategy (EG) and those taught with conventional method (CG) hereby rejected.

Null Hypothesis Three:

HO₃: There is no significant difference between attitude of male and female students taught Algebra with problem solving strategy (EG)

Table 4.13: Independent Sample t-test Statistics for difference in Attitude between Male and Female Students in Experimental Group

Gender	N	Mean	std.dev	Df	T	P
Male	82	13.78	3.12			
Female	76	13.43	3.42	156	5.582	0.001

$p \leq 0.005$ level of significance

Table 4.13 of independent t-test showed that the difference in attitude scores between male students (n =82, M = 13.78, SD = 3.12) and female students (n = 76, M = 13.43, SD = 3.42) was not statistically significant $t(c) = 5.582, P = 0.001$ 95%, $df = 156$. This showed that there is significant effect of problem solving method in the attitude of male and female students taught algebra by means of problem solving. Consequently, the null hypothesis which states that there is no significant difference between attitude of male and female students taught Algebra with problem solving strategy (EG) was hereby rejected.

Null Hypothesis Four:

HO₄: There is no significant difference between performance of male and female students taught Algebra with problem solving strategy (EG)

Table 4.14: Independent Sample t-test Statistics for difference in Performance between Male and Female Students in Experimental Group

Gender	N	Mean	std.dev	Df	T	P
Male	82	22.03	3.79	156	6.316	0.001
Female	76	22.48	3.84			

p≤0.005 level of significance

Table 4.14 of independent t-test showed that the difference in performance scores between male students (n = 82, M = 22.03, SD = 3.79) and female students (n = 76, M = 22.48, SD = 3.84) was not statistically significant $t(c) = 1.81$, $P = 0.001$, 95%, $df = 156$. This showed that there is significant effect of problem solving strategy in the performance of male and female students exposed to algebra by means of problem solving. Consequently, the null hypothesis which states that there is no significant difference between performance of male and female students taught Algebra with problem solving strategy (EG) was hereby rejected.

Null Hypothesis Five:

HO₅: There is no significant difference between performance students from Urban and Rural areas taught Algebra with problem solving strategy (EG)

Table 4.14: Independent Sample t-test Statistics for difference in Performance between Students from Urban and Rural Schools in Experimental Group

School Location	N	Mean	std.dev	Df	T	P
Urban	84	21.13	4.09	156	4.080	0.001
Rural	74	20.80	4.05			

p≤0.005 level of significance

The results of Table 4.14 revealed the independent sample t-test statistics that indicated that the difference in performance scores of urban students ($n = 84$, $M = 21.13$, $SD = 4.09$) and rural students ($n = 74$, $M = 20.80$, $SD = 4.05$) was statistically significant $t(c) = 4.080$, $P = 0,001$, 95% , $df = 156$. This showed that there is significant effect of problem solving strategy in the performance of students taught algebra by means of problem solving with respect to school location. Consequently, the null hypothesis which states that “There is no significant difference between performance of students from Urban and Rural areas taught Algebra with problem solving strategy (EG) was hereby rejected”.

4.4 Summary of the major findings

The followings are the summary of the major findings of the study:

1. Problem solving strategy has significant effect on students’ attitude towards algebra
2. Also Problem solving strategy has significant effect on students’ performance in algebra.
3. Male and female students significantly differed in attitude when taught algebra with solving strategy.
4. There is significant deference in performance between male and female student taught using problem solving strategy.
5. The higher the students level of attitude the higher their performance in algebra and vice versa.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.0 INTRODUCTION

This study was set to investigate the effect of problem solving instructional strategy on attitude and performance in algebra among secondary school students of Kaduna State, Nigeria. The final chapter of this research work was dedicated to the following subheadings:

5.1 Summary

This study assessed the effect of problem solving instructional method on attitude and academic performance of students in algebra among secondary school students of Kaduna State, Nigeria. The results of the data analyzed revealed that:

- I. Problem solving instructional method had an influence on students' attitude in algebra.
- II. Problem solving instructional method had a significant effect on students' performance in algebra.
- III. Male and female students do not differed significantly in their attitude scores when exposed to treatment of problem-solving strategy.
- IV. The performance of male and female students did not differ significantly when exposed to the treatment of Problem-Solving Strategy.
- V. The higher the students level of attitude the higher their performance in Algebra and vice-verse.

5.2 Conclusion

Based on the result of the hypothesis, the following conclusions can be deduced:

Problem solving instructional on method has a positive effect on the academic performance scores on algebraic concept of mathematics. Students and teachers from rural areas should be encouraged and motivated more by exposing them to more problems solving strategy as students performance in algebra was affected by school location.

However, gender was not found to be a factor as problem solving instructional method in this study carried both sexes along. The poor performance of Nigerian students in mathematics examinations portrayed danger for a country in quest of technological advancement. Hence, all hands must be on deck to make the acquisition of mathematics knowledge possible for all students for the benefit of all. The finding of this research work has further established the fact that acceptable methods of instruction are capable of changing students' performance and attitude towards algebra.

5.3 Recommendations

Based on the outcome of this study, the following recommendations are hereby put forward.

1. Mathematics teachers should be given all needed encouragement and motivation to use the problem solving method in place of the conventional lecture method for better academic performance.
2. Teachers who have mastery of algebra should be used in the teaching of algebra.
3. Students' attitude towards the learning of algebra can be improved by using teachers who are well qualified in the mathematics as a subject in general.
4. Teachers should develop cordial, friendly and caring relationship with their students in order to improve the teaching and learning process in Mathematics.

5. Positive attitude towards learning and performing well in algebra are necessary ingredients in senior secondary school Mathematics education. There is need for teachers, parents and any other education stakeholder to enhance these positive attitudes.
6. Efforts should be made to ensure does not hinder learning and/or performance in algebra among students. Teachers, parents and siblings of the students should encourage both the female and male learners to equally embrace mathematics generally.
7. The un favourable attitude should be curtailed professionally and early enough before students utterly give up in learning and/or performance of mathematics.
8. The recommendations of algebraic textbooks for use in schools should be taken very seriously and should be based on nothing other than the text satisfying the features of a good algebraic textbook that will secure students' interest in learning algebra.
9. Problem solving instructional strategy should be used in teaching algebra at both primary and secondary levels of education.
10. Efforts made at carrying out researches should not be allowed to waste away. Research result should be made to reach the implementation of the findings to be able to achieve the desired results.
11. Authors of algebraic textbooks should include the instructional strategy at which each topic should be taught in their textbooks.
12. Mathematics teachers should take turns in attending workshops and seminars and each person on return should expose others in the school to the knowledge they acquired during the training.

5.4 Suggestions for further studies.

The study is by no means exhaustive. Further studies can be carried out especially on:

- I. Similar study on effect of problem solving instructional method on students' interest and performance in geometry and other aspects of mathematics could be carried out.
- II. This study could be replicated in other parts of Nigeria.
- III. The study was restricted to government owned schools; it could be also be extended to private and organizational owned schools.

References

- Abagana, S.M.(2011).The effect of Teachers Sensitizations Secondary School level of Acquisition of Science process skills. (Doctoral Dissertation. Faculty of Education, University of Nigeria ,Nsukka).
- Aborisade O.j (2009). Constructions and Validation of Mathematics Attitude scale for Secondary Schools Students in elite State. University of Ado Ekiti, Nigeria
- Adebule,S.O (2004) Gender Difference on Locally Standardized Anxiety Rating scale in Mathematics for Nigeria secondary schools. Unpublished Theses of the University of Ado-Ekiti, Nigeria.
- Aina, R. I. (1982). Some Aspects of Cognitive Development and the Learning of Science Concepts: a Conceptual framework for diagnosis and Strategy. African Journal of Education research 3(2), 16 – 19.
- Beaton, A. E., Mullies, V. S., Martin, O., Gonzale, E. J., Kelly, D. L. & Smith, T. A. (1996). Mathematics Achievement in the Middle School Years: Third International Mathematics and Science Study (TIMSS) Chestnut Hill, M. A: Boston College.
- Bednar, A., & Levie, W. H. (1993). “Attitude Change Principles”. In Instructional Message Design: Principles from the Behavioural and Cognitive Science by Englewood Cliffs, N. J. Educational technology Publications. 2(1), 283 – 304.
- Blum, R. W. M. & Libbey, H. P. (2004). Executive Summary. Journal of School Health 74(7), 224 – 283.
- Bolaji, C. (1997). Effects of Historical Method Students Performance in Mathematics. A Paper Presented at the 13th Annual National Conference of Mathematical Association of Nigeria Held at Abuja, FCT, September 1st – 6th 1997.
- Bolaji, C. (2005). “A Study of Factors Influencing Students’ Attitude Towards Mathematics in the Junior Secondary Schools: Mathematics Teaching in Nigeria”. Retrieved on August 5, 2015 from <http://www.2.ncsu.edu/ncsu/aern/bolajim.htm/>
- Boliner, G. & Wanke, M. (2002). “Attitudes and Attitude Change”. New York: Psychology Press, Taylor & Francis Group.

- Butty, J. A. M. (2001). Teacher Instruction, Student Attitude and Mathematics Performance among 10th and 12th grade black and Hispanic Students. *Journal of Negro Education* 70(1/2), 19-37.
- Byrne, B., & Shavelson, R. J. (1987). Adolescents self-concept: Testing the Assumption of Equivalent Structure Across Gender. *American Educational Research Journal* 24(3), 365-368.
- Campbell, J. R., Connolly, C. & Pizoo, J. (1986). Self concept and attribution of gifted Students in Advanced School Science and math classes. Paper presented at the annual Meeting of American Educational Research Association San Francisco.
- Carr, M. & Jessup, D. L. (1997). Gender Difference in first grade Mathematics Strategy use: Social and Metacognitive Influence. *Journal of Education Psychology* 98: 318 – 328.
- Chima, O. (2002). The Effects of three Methods of Remedial Teaching on Students' Achievement in Selected Topic in College Algebra. *Journal of Education* 8(6). 16-18.
- Cockcroft, W. H. (1982). *Mathematics Counts*. London: H. M. Stationary Office.
- Cosello, J. (1991). *Teaching and Learning of Mathematics* 11-16. London: Rutledge.
- Ding, C. S; Song, K. & Richardson, I. L; (2007). Do Mathematics Gender Difference Continue? *Educational Study*: 279-295.
- Edeh, A. C. (2008). *Teaching and Learning of Mathematics in Nigerian Schools and Colleges*. Otuoka, Uncle Undujum Publications.
- Emenalo, R. A. (1986). Relationship Between Students' Motivation and their Science Achievement. *Journal of Research in School Teaching*, 15(3), 10-15.
- Federal Republic of Nigeria (2004). "National Policy on Education". 4th Edition, Lagos NERDC Press.
- Fennema, E. & Sherma, J. A. (1976). Fennema-Sherma Mathematics Attitude Scales: Instruments Designed to Measure Attitude towards the Learning of Mathematics by female and males. *Journal for research in Mathematics Education*, 94(6), 314-322.
- Fullan, M. (2001). *Learning in a Culture of Change*. San Francisco. Jossey-Bass.
- Fullarton, S. (2004). Closing the gaps between Schools: Accounting for Variation in Mathematics Achievement in Australian Schools using TIMSS 95 and TIMSS 99.

- In Proceedings of the IRC – 2004 TIMSS Vol. (ed) C. Papanastasion (Cypus University. Nicosia, 2004) 16 – 31.
- Gallagher, A. M. & Kaufman, J.C. (2006). Gender Difference in Mathematics: On Integrative Psychological Approach. 54(2), 245-247.
- Gbamanja, S. P. T. (2001). Modern Methods in Science Education in Africa. Jeson Service, Port-Harcourt.
- Geary, D. C., Saults, F., Liu & Hoard, M. K. (2000). Sex Difference in Spatial Cognition, Computational Fluency, and Arithmetical Reasoning. *Journal of Experimental Child Psychology*, 73(4), 419 – 425.
- Gire, J. T. (1988). The Relationship Between Mathematics Attitudes and Performance. *Nigeria Journal of Basic and Applied Psychology* 1(1), 96-112.
- Hammouri, H. A. M. (2004). Attitudinal and Motivational Variable related to Mathematics Achievement in Jordan, *Educational Research*, 46(3) 241-257.
- Hart, L. (1989). “Describing the Affective Domain. Saying what we Mean” In *Affective and Mathematics Problem Solving* by Mcloed & Adams, Eds, Springer Verlay: New York 37-45. *Journal of Education*.
- Hill, P. W. & Rowe, R. J. (1996). Multi-level modeling in school Effectiveness Research and school improvement. *Journal of Education* 7(40).
- House, D. J. (2004). Motivational Qualities of Instructional Strategies and Computer use for Mathematics Teaching in Japan and United State. *Internal Journal of Instructional Media*. 32(1), Academic Research Library.
- Howie, S.J.(2002). English Language Proficiency and Contextual Factors Influencing Mathematic Achievement of Secondary School Pupils in South Africa. Enscheda. Doctoral Dissertation University of Twente.
- Ibebuike, K.I (2006). Achievement motives and text anxiety conceived as motive to avoid failure. *Journal of Social Psychology*. 5(3), 8-12
- Igomu, A.I (2009). Factors Influencing the use of Instructional Materials by Mathematics Teachers among public and Private Secondary Schools in Botwana *NACTAJournal*.
- Janson, S. (1996). The Contribution of Large scale Assessment Program to Research on gender Differences. *Educational Research and Evaluation* 2, 25 -49.

- Kamradt, T.F., and Kamradt, E.J.(1999) “Structured Design for Attritional Instruction” in Instructional – Design Theories and models: A New Paradigm of Instructional Theory by C.M Reigeluth, Ed, Mahwah, N.J: Lawrence Erlbaum, Vol.2 B 63- 590.
- Kimura, D. (2002). Sex Difference in the Brain Scientific American Special Edition 12: 32-37.
- Krulik, S and Rudnick, J.A (1980): Problem Solving: A Handbook for Teachers Allyn and Beason, Inc. Boston.
- Lester, R.K (1980): Research on Mathematical problem solving in: Shumway, R.J (Ed): Research in Mathematics Education. NCTM.
- Macnab, D.S and Cummine, J .A (1986). Teaching Mathematics 11-16. A Difficult centered Approach. London: Basil Balckwell Ltd.
- Manouchechri, R.I (2002). Effect of socio-Economic Background of children in schools: Journal of Education Psychology. 63(1), 129-132.
- Marjoribanks, K. (2002). Family and school capital: Towards a context Theory of students’ school outcomes. Dordecht: Kluwer Academic Publishers
- Mullis, I.V.S, Martin, M.O. Gonzalesz, E.J, and Chrostowski, S.J (2004). TIMSS 2003 International Mathematics Reports: Finding from IEA’S Trend in International Mathematics and Science study at the fourth and Eighth grades: Chestnut Hill Boston College.
- Musal, M. (2013). An Appraisal of Mathematics –Teachers’ skills in problem solving for the 21st Century. Ahmady Bello University journal, Zaria, Nigeria.
- Musa, M. and David, E. S. (2014): Trends Analysis of Students’ Mathematics Performance in West African Senior Secondary Certificate Examination from 2010 -2013: Implication for Nigeria’s Vision 20:20. British Journal of Education. 2(7), 50 – 64 www.eajournals.org.
- Mohd, N, Mahmood, T.F.P.T. and Ismail M.N(2011). Factors that influence students in Mathematics Achievement. International: Journal of Academic Research, 3(3), 49-54
- Nielsen, H.B (2003). One of the boys? World Organization of the Scout Movement.

- NMC. Abuja, (2009) ‘Mathematics Improvement programme’ [www.ncmcabuja.org/mathematics Improvement Programmes.htm/](http://www.ncmcabuja.org/mathematics%20Improvement%20Programmes.htm/). Retrieved on 5th August, 2015.
- Nzewi, P.(2008). An Introduction to Mathematics for Higher Education in Nigeria. Onitsha: Network Publishers Ltd.
- Obiom, T.M (2004). Enhancing Teaching and Learning of Mathematics Through Instructional Media in Secondary Schools in Enugu State. Unpublished Thesis University of Jos.
- O’connor –Petruso, S.M, Shiering, B.H and Serrano. B (2004)’ Pedagogical and parent Influence in Mathematics Achievement by Gender among selected European countries from the TIMSS –R study’. In Proceedings of the IRC – 2004 TIMSS Vol 11 (Ed). C Papnastatious Cyprus University, Nicosia, (2004) 69 -84.
- Ojo.S.G (2008). Problem solving Techniques A paper presented at capacity Building workshop for secondary school Mathematics Teachers in Nigeria, NMC Abuja Marvelous press Limited MDG.S capital Project.
- Ojoko, S.S. (2001). Agricultural Education: Theory and Practice. Owerii Springfield publishers .
- Okeke, E.C. (2003). Gender and Sexuality Education: Bridging the Gap in Human Resource Development. Journal of Curriculum Organization of Nigeria 10(1). 117 - 120.
- Olayiwola, A. O. (2010). Procedures in Educational Research. Nigeria: HANJAM Publications. <http://www.hrhc-drhc.gc.ca/arb/> Retrieved August 14 2012.
- Onuh, I.S. (2011). Current Trend in Mathematics Instruction . Abeokuta: GOAD Educational Publishers
- Orton, A (1987). Learning Mathematics Issues, Theory and Classroom Practices . London: Cassel Education Ltd
- Oyifioda, C.I (2006). Environment and Sex on Mathematics Achievement Abacus Journal.
- Polya, G. (1945, 2nd edition, 1957). How to solve it. Princeton, NJ: Princeton University Press.

- Russell, S.(1983). Factors Influencing the choice of Advanced level Mathematics by Boys and Girls. London University of Leeds.
- Salau, M.O (2002). Strategies for Sustaining Mathematics as an Indispensable tool for Sustainable Technological development in the 21st century. STAN proceeding of 43rd annual conference and Inaugural conference of CASTME Africa 2002.
- Sarwar, M. (2002)'' A Comparison of study Habits and Attitudes of low and High Achievement at Secondary level''. M.Phil. Thesis Uni. A. I.O Islamabad. 124.
- Shah, M. (2002). ''Comparative Effectiveness of Teacher Training in Enhancing the Professional Attitudes of B.Ed Students Admitted in institute of Education and Research NWFP'' College of Education Islamabad and Allama iqbal Open University Islamabad, Ph.D Thesis Uni. A.I.O Islamabad P.232.
- Sokoya, A. (2011). Psychology and Law enforcement: An Introductory text. Oji River: Entity business concepts ventures.
- Springer, D.M and Alsup, J.K (2003). An analysis of gender and the mathematics reasoning ability sub-skill of analysis – synthesis Education. 123(4). 120 -123.
- Spiegel M (1992). Synthesizing evaluation perspectives, practices and evidences, proceedings of the American evaluation Association: 92 Extension evaluation Topical interest group, Seattle WA, 27-37.
- Stevens, J (1986) Applied multivariate statistics for the social sciences: Hillsdale: NJ: Erlbaum.
- Tapia, M. and Marsh 11, G.E (2004). An instrument to measure Mathematics attitudes. Academic Exchange Quarterly. 8(2), 130 -143.
- Twoli, N.W (1986). Sex difference in science Achievement Among Secondary School Students in Kenya. Unpublished Ph.D Thesis. Flinders University of South Australia.
- Umoh, C.G (2003). A Theoretical Analysis of the Effects of Gender and Family Education on Human Resource Development: Journal of Curriculum Organization of Nigeria , 10(1), 1 – 4,
- Weber, K (2008). ''Mathematics Validation of Proofs'' Journal for Research in Mathematics Education. 39(4), 431 – 459

- Ying, W.N and Ching, C.S (1991), "Attitudes towards Learning mathematics Among Secondary School Students in Hong Kong". Educational Journal 19(1), 13 – 18.
- Zan, R and Martino, P.D., (2007). "Attitudes towards Mathematics: Overcoming positive/Negative Dichotomy" The Montana Mathematics Enthusiasts Monograph. 3(1) 157 – 169.

Appendix A:

Frequency Table

		GRPUPS			
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Problem solving Experimental	158	66.4	66.4	66.4
	Conventional Control	80	33.6	33.6	100.0
	Total	238	100.0	100.0	

		Location			
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Urban	126	52.9	52.9	52.9
	Rural	112	47.1	47.1	100.0
	Total	238	100.0	100.0	

		Sex			
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Male	123	51.7	51.7	51.7
	Female	115	48.3	48.3	100.0
	Total	238	100.0	100.0	

Frequencies

		Statistics				
		students have positive attitude towards the learning of mathematics especially algebra	I believe my maths teacher teach the subject of algebra effectively	I look forward to the matrhe algebra lesson	i like the giving of relevant and adequate assignments on the issues taught	I consider the mathematics teacher to have the subject mastery
N	Valid	238	238	238	238	238
	Missing	0	0	0	0	0
Mean		2.5756	2.7689	2.8992	2.6807	2.8067
Std. Deviation		1.02734	1.15157	1.01794	1.10947	1.01281

Frequency Table

students have positive attitude towards the learning of mathematics especially algebra

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	SD	42	17.6	17.6	17.6
	D	71	29.8	29.8	47.5
	AG	71	29.8	29.8	77.3
	SA	54	22.7	22.7	100.0
	Total	238	100.0	100.0	

I believe my math's teacher teach the subject of algebra effectively

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	SD	48	20.2	20.2	20.2
	D	47	19.7	19.7	39.9
	AG	55	23.1	23.1	63.0
	SA	88	37.0	37.0	100.0
	Total	238	100.0	100.0	

I look forward to the math algebra lesson

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	SD	25	10.5	10.5	10.5
	D	61	25.6	25.6	36.1
	AG	65	27.3	27.3	63.4
	SA	87	36.6	36.6	100.0
	Total	238	100.0	100.0	

i like the giving of relevant and adequate assignments on the issues taught

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	SD	49	20.6	20.6	20.6
	D	49	20.6	20.6	41.2
	AG	69	29.0	29.0	70.2
	SA	71	29.8	29.8	100.0
	Total	238	100.0	100.0	

I consider the mathematics teacher to have the subject mastery

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	SD	29	12.2	12.2	12.2
	D	62	26.1	26.1	38.2
	AG	73	30.7	30.7	68.9
	SA	74	31.1	31.1	100.0
	Total	238	100.0	100.0	

T-Test

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	pretest	19.9557	158	3.81807	.30375
	Posttest	24.5316	158	3.90275	.31049

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	pretest & Posttest	158	.948	.000

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	pretest - Posttest	-4.57595	1.24815	.09930	-4.77208	-4.37982	46.083	157	.000

Correlations

Descriptive Statistics

	Mean	Std. Deviation	N
Performance	20.9727	4.06517	238
ATTITUDE	13.7311	3.06800	238

Correlations

		Performance	ATTITUDE
Performance	Pearson Correlation	1	.627**
	Sig. (2-tailed)		.000
	N	238	238
ATTITUDE	Pearson Correlation	.627**	1
	Sig. (2-tailed)	.000	
	N	238	238

** . Correlation is significant at the 0.01 level (2-tailed).

T-Test

Group Statistics

		GRPUPS	N	Mean	Std. Deviation	Std. Error Mean
Performance	Problem solving Experimental		158	22.2437	3.80987	.30310
	Conventional Control		80	18.4625	3.33449	.37281

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Performance	Equal variances assumed	.677	.411	7.534	236	.000	3.78117	.50190	2.79240	4.76994
	Equal variances not assumed			7.870	178.672	.000	3.78117	.48047	2.83304	4.72930

Univariate Analysis of Variance

Warnings

Post hoc tests are not performed for GRPUPS because there are fewer than three groups.

Between-Subjects Factors

		Value Label	N
sex	1.00	Male	123
	2.00	Female	115
GRPUPS	1.00	Problem solving Experimental	158
	2.00	Conventional Control	80

Descriptive Statistics

Dependent Variable: Performance

sex	GRPUPS	Mean	Std. Deviation	N
Male	Problem solving Experimental	22.0301	3.79373	83
	Conventional Control	18.9625	3.65918	40
	Total	21.0325	4.00447	123
Female	Problem solving Experimental	22.4800	3.83920	75
	Conventional Control	17.9625	2.93604	40
	Total	20.9087	4.14569	115
Total	Problem solving Experimental	22.2437	3.80987	158
	Conventional Control	18.4625	3.33449	80
	Total	20.9727	4.06517	238

Tests of Between-Subjects Effects

Dependent Variable: Performance

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	787.290 ^a	3	262.430	19.624	.000
Intercept	87974.855	1	87974.855	6578.543	.000
Sex	4.015	1	4.015	.300	.584
GROUPS	763.238	1	763.238	57.073	.000
Sex * GROUPS	27.887	1	27.887	2.085	.150
Error	3129.282	234	13.373		
Total	108601.750	238			
Corrected Total	3916.572	237			

a. R Squared = .201 (Adjusted R Squared = .191)

Estimated Marginal Means

Grand Mean

Dependent Variable: Performance

Mean	Std. Error	95% Confidence Interval	
		Lower Bound	Upper Bound
20.359	.251	19.864	20.853

```
T-TEST GROUPS=Location(1 2)
/MISSING=ANALYSIS
/VARIABLES=Performance
/CRITERIA=CI(.95).
```

T-Test

Group Statistics

	Location	N	Mean	Std. Deviation	Std. Error Mean
Performance	Urban	126	21.1341	4.09171	.36894
	Rural	112	20.8000	4.04731	.37741

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Performance	Equal variances assumed	.104	.747	.633	236	.527	.33415	.52798	-.70601	1.37430
	Equal variances not assumed			.633	235.245	.527	.33415	.52778	-.70564	1.37393

APPENDIX B

Pre test and Post test reliability using PPMC

Raw scores of the two sets of tests for determining the coefficient of reliability of the test instrument

S/NO	X	Y	X ²	Y ²	XY
1	25	30	625	900	750
2	25	30	625	900	750
3	23	28	529	784	644
4	21	24	441	576	504
5	23	27	529	729	621
6	21	25	441	625	525
7	21	25	441	625	525
8	23	26	529	676	598
9	21	24	441	576	504
10	23	25	529	625	575
11	24	29	576	841	696
12	19	24	361	576	456
13	18	23	324	529	414
14	21	26	441	676	546
15	26	31	676	961	806
16	12	17	144	289	204
17	21	26	441	676	546
18	21	22	441	484	462
19	16	21	256	441	336
20	17	22	289	484	374
21	16	20	256	400	320
22	14	16	196	256	224
23	11	17	121	289	187
24	21	26	441	676	546
25	20	25	400	625	500
26	19	24	361	576	456
27	15	20	225	400	300
28	16	21	256	441	336
29	25	30	625	900	750
30	25	30	625	900	750
31	23	28	529	784	644
32	21	25	441	625	525
33	23	28	529	784	644
34	21	26	441	676	546
35	21	24	441	576	504
36	23	28	529	784	644
37	21	26	441	676	546
38	23	28	529	784	644
39	24	29	576	841	696
40	19	24	361	576	456
$\Sigma N=40$	$\Sigma X=822$	$\Sigma Y=1000$	$\Sigma X^2=17402$	$\Sigma Y^2=25542$	$\Sigma XY=21054$

Note: x and y are first and second tests scores for 40 STUDENTS USED FOR PILOT STUDY

APPENDIX C

(Statistics for finding reliability)

Pearson Product Moment Correlation computed for the Reliability index for the instrument used in the pilot study of the research.

The formula for Pearson Product Moment Correlation is given below:

$$\frac{N\sum(XY) - \sum(X)\sum(Y)}{\sqrt{[(N\sum X^2 - (\sum X)^2)(N\sum Y^2 - (\sum Y)^2)]}}$$

N= Number of respondents

X is pretest scores

Y is posttest scores

$\sum X$ is sum of pretest scores

$\sum Y$ is sum of posttest scores

$\sum X^2$ is sum of square pretest scores

$\sum Y^2$ is sum of square posttest scores

$(\sum X)^2$ is square sum of pretest scores

$(\sum Y)^2$ is square sum of posttest scores

$\sum XY$ is sum of product of pretest and posttest scores

Where:

$$\sum X = 822, \sum Y = 1000 \quad \sum X^2 = 17402, \sum Y^2 = 25542, \sum XY = 21054 \text{ and } N = 40$$

Substituting in values in the equation, we have:

$$R = \frac{40 \times 21054 - 822 \times 1000}{\sqrt{[(40 \times 17402 - 822^2)(40 \times 25542 - 1000^2)]}} = 0.891$$

APPENDIX D

Department of Mathematics Education,
Faculty of Education,
Ahmadu Bello University, Zaria.
4th June, 2015.

Dear Respondent,

QUESTIONNAIRE ON ALGEBRAIC ATTITUDE

I am a master's student of department of Mathematics Education, Ahmadu Bello University, Zaria currently conducting a research on Effects of Problem Solving Strategy on Attitude and Performance in Algebra Among Senior Secondary School Students in Kaduna State Nigeria. I am hereby soliciting for your support to answering the questions.

I however, wish to inform you that any information collected from you will be treated confidentially for it will only be used for the purpose of this research work.

Thanks for your cooperation.

Yours faithfully,

Safiya Shu'aibu

INSTRUCTION:

This questionnaire is divided into two sections: Section A – Bio Data, section B – Algebraic attitude question. In each of the section, list of questions are provided with corresponding boxes. Simply tick [] the appropriate box that represent your feelings. The following options are orderly provided. SA – (Strongly Agree), A –(Agree), D (Disagree), SD (Strongly Disagree), which represent your feelings on each question. If you make a mistake, cross by putting (x) through the tick () and then tick in the appropriate box.

SECTION A: BIO DATA

1. Gender: Male [] Female []
2. Age Group: 15 – 17 [] 18 – 20 [] 20 and above []
3. Location of school: Urban [] Rural []
4. Type of school: Boys [] Girls [] Mixed []

SECTION B:

S/NO	Items	Response categories			
		SA	A	D	SD
1	students have positive attitude towards the learning of mathematics especially algebra				
2	I believe my math's teacher teach the subject of algebra effectively				
3	I look forward to the math algebra lesson				
4	I like the giving of relevant and adequate assignments on the issues taught				
5	I consider the mathematics teacher to have the subject mastery				

APPENDIX E

AUTHORIZATION LETTER

Department of Mathematics Education,
Faculty of Education,
Ahmadu Bello University, Zaria.
4th June, 2015.

The Permanent Secretary,
Kaduna State Ministry of Education,
Kaduna.

Dear Sir/Madam

RESEARCH AUTHORIZATION

I write to introduce Safiya Shu'aibu who is a postgraduate students of this university. she is registered for M.Ed degree programme in the Faculty of Education, Department of Mathematics Education.

Safiya Shu'aibu intends to conduct research for a thesis entitled "Effect of Problem Solving Strategy on Attitude and Performance in Algebra among Senior Secondary School Students in Kaduna State, Nigeria".

Any assistance given to her will be highly appreciated.

Yours faithfully,

Dr. Maruf O. Ibrahim
(Project Supervisor)

APPENDIX F

LESSON PLANS ON CONVENTIONAL TEACHINGS METHOD

Teacher's guide to conventional teaching method

This is a technique that is widely one man show with uninvolved audience (zero audience). Class is normally dominated by lectures or direct instruction focusing on textbook materials.

Students sit passively and watch the teacher solves mathematics problems on the board and copy what the teacher does, with little or no opportunity for students to ask questions, make contributions or independent thought.

Attention must be paid to the following:

1. Minimal students' interaction (chalks and talks only).
2. Activities are mostly dominated by teacher giving only examples, without using solid teaching aids.
3. Little opportunity to ask questions.

LESSON 1

Subject: Mathematics

Class: SS II

Duration: Double periods of 40 minutes each

Average Age: 16 years

Topic: Indices and Logarithms.

Objective: Students should be able to: (i) use laws of indices in calculations (ii) solve exponential equations with the aid of laws of indices; (iii) apply laws of theory of logarithms in problem solving and (iv) use logarithm tables in calculations.

Teaching aids: Chalkboard, mathematical tables and textbooks.

Instructional techniques: Reference to teacher's instructional guide.

Instructional procedure:

Step I: Use the knowledge of indices to show how a given number or numbers can be put in their index forms. Explain the relationship between base, power and number.

- Step II: Teach how to use the concept of prime factors to put numbers in their required index form.
- Step III: Use the idea of prime factors to show the product of prime factors of numbers such as: 4, 8, 16, 9, 27 etc.
- Step IV: Explain the meaning of logarithm of a number.
- Step V: Evaluation on operations with surds.
- Step VI: Explain the laws or rules of logarithms.
- Evaluation:
- i. Explain the relationship between exponential equation and logarithmic equation.
 - ii. Give cupiuos examples on the application of the laws of indices and logarithms.

LESSON 2

- Subject: Mathematics
- Class: SS III
- Duration: Double periods of 40 minutes each.
- Average Age: 16 years
- Topic: Surds
- Objective: Students should be able to: simplify, rationalize and carryout operations involving surds.
- Teaching Aids: Chalkboards and textbook.
- Instructional Technique: Follow the teacher's instructional guide.
- Instructional Procedure:
- Step I: Define each of the following:
- a. Rational number.
 - b. Irration number (surds)
- Step II: Show how number can be simplified; by making the number under the root sign as small as possible.
- Step III: Teach the idea of conjugate binomial surds say $(\sqrt{a} + \sqrt{b})$ and $(\sqrt{a} - \sqrt{b})$.

Step IV: Explain the general principles of rationalization of surds whose denominators are irrational.

Step V: Illustrate or demonstrate how the product of two conjugate surds can be a rational number. Thus:

$$(\sqrt{a} + \sqrt{b})(\sqrt{a} - \sqrt{b}) = a - b.$$

Evaluation:

- i. Simplify (i) $\sqrt{8} + \sqrt{18} - \sqrt{24}$ (ii) $\sqrt{25} - \sqrt{75} + \sqrt{5}$
- ii. Rationalize the denominators of the following surds:
(i) $6/2\sqrt{2} - 1$ (ii) $2\sqrt{3} + 2/2\sqrt{3} - 2$

LESSON 3

Subject: Mathematics

Class: SS II

Duration: Double periods of 40 minutes each.

Average Age: 16 years

Topic: Probability

Objective: Students should be able to: (i) Explain probability of an event, (ii) calculate the probability of an event (iii) solve simple problems on probability.

Teaching Aids: Chalkboards, poker cards, die or dice and coins.

Instructional Technique: Refer to teacher's instructional guide above.

Instructional procedure:

Step I:
i. Define the term probability and give examples.
ii. Discuss the various types of probabilities, say (i) mutually exclusive event, (ii) Multiplication law of probability, (iii) dependent and independent events.

Step III: Explain the concept of probability games and simulations; using die, dice coins and playing cards.

Step IV: Engage the students in partaking in probability games listed in step III.

Step V: Determine the probability of the following: (i) mutually exclusive events, and (ii) dependent and independent events.

Step VI: Demonstrate multiplication and addition laws of probability.

Evaluation:

- i. Find the probability that a number chosen at random from the integers between 10 and 20 is either a prime or a multiple of 3.
- ii. In a game of fair die is rolled once and two unbiased coins are tossed once. What is the probability of getting 3 and a tail?

LESSON 4

Subject: Mathematics

Class: SS II

Duration: Double periods of 40 minutes each.

Average Age: 16 years

Topic: Sequences and Series

Objective: Students should be able to:

- i. Identify a sequence
- ii. Find the n th term of a sequence.
- iii. Find the sum of finite series and
- iv. Solve problems on sequences and finite series.

Teaching Aids: Chalkboard, duster and textbook.

Instructional Technique: Refer to teacher's instructional guide.

Instructional Procedure:

Step I: Define the following: sequence, series, arithmetic progression and geometric progression. Give examples.

Step II: Use table to explain the n th term of a sequence.

Step III: Show different formulae used to calculate sum of n terms of a given sequence and sum to infinity (\sum_{∞}) of a geometric progression series.

Step IV: Explain the theory of sum to infinity of a G.P series.

Evaluation:

- i. The sum of first 9th terms of an A.P. is 72 and the sum of the next 4 terms is 71. Find the A. P.
- ii. The common ratio of a G. P. is 2.7 and the 5th term is greater than the first term by 45, find the 5th term.

LESSON 5

Subject: Mathematics

Class: SS II

Average Age: 16years

Duration: Double periods of 40 minutes each.

Topic: Literal equations and quadratic Functions/Equations.

Objective: Student should be able to: solve problems on literal equations, substitution into formula and quadratic equations using different methods.

Teaching Aids: Chalkboard, duster and textbook.

Instructional Technique: Follow the teacher's instructional guide

Instructional Procedure:

Step I: Definition of: simple equation, literal equation and quadratic equation.

- i. Simple equation: is an equation in one variable (unknown). For example, $2x = 4$
- ii. Literal equation is an equation in terms of letters. For example $x = a+b$.
- iii. Quadratic equation is an equation whose highest power of variable (unknown) is two (2). For example:
 $ax^2 + bx + c = 0$

Step II: Explain quadratic function of the type; $y = ax^2 + bx + c$.

Step III: Show how simple equations and quadratic equations can be solved.

Step IV: Teach the skill of factorization by grouping in a general quadratic expression such as $ax^2 + bx + c$. show the method of solving simultaneous equations.

Step V: Explain the types of roots of a quadratic equation.

Evaluation:

- i. Use the quadratic formula to solve the following equations.
 - a. $x^2 + 5x + 6 = 0$
 - b. $12b^2 - 35b = 0$
 - c. $15p^2 + P = 1$
- ii. Solve the following equations by factorization method:
 - a. $X^2 - 7x + 10 = 0$
 - b. $2x^2 - 3x - 5 = 0$

LESSON 6

Subject: Mathematics

Class: SS II

Average Age: 16years

Duration: Double periods of 40 minutes each.

Topic: Change of subject and variations.

Objective: Student should be able to:

- i. Make a required variable subject of the formula (relation).
- ii. Solve problems on variations with the idea of change subject.
- iii. Solve problems on change of subject.

Teaching Aids: Chalkboard, chart, ruler and textbook.

Instructional Technique: Follow the teacher's instructional guide

Instructional Procedure:

Step I: Explain what a formula is.

- Step II: Show how a required variable can be expressed in terms of other quantities in the formula.
- Step III: Explain the different types of variations, namely:
- i. Direct variation
 - ii. Inverse variation.
 - iii. Joint variation.
 - iv. Partial variation.
- Step IV: Show how the knowledge of the change of subject of the formula can be used in solving problems on variations.
- Step V: Explain how to put a given variation problem into a mathematical model (equation or equations).
- Evaluation:
- i. Make y the subject of the formula if $a = c(1+y)$
 - ii. The volume V of a cone of height h and base radius r is given by the formula $V = \frac{1}{3}\pi r^2 h$
 - a. Change the subject of the formula to r .
 - b. Calculate the base radius of a cone of height 14cm and volume 33cm^3 taking $\pi = \frac{22}{7}$
 - iii. P varies directly as the square of Q , if $P = 27$ when $Q = 6$. Find the equation relating P and Q . find P when $Q = 10$ and Q when $P = 18\frac{3}{4}$

LESSON 7

- Subject: Mathematics
- Class: SSII
- Duration: Double periods of 40mins each
- Average age: 16yrs
- Topic: Inequalities
- Objective: Students should be able to:
- i. Solve problems on inequalities
 - ii. Represent solution sets of inequality on a number line

iii. Solve graphically inequalities in two variables say x and y .

Teaching aids: Ruler graph, chalkboard.

Instructional technique: Follow the teacher's instructional guide

Instructional procedure:

- Step I: Define the term inequality. Give examples of inequalities in real life situation.
- Step II: Teach inequalities signs and symbols such as $>$, $<$, \geq , and \leq .
- Step III: Explain how to solve an inequality problems in one variable and Representation of solutions sets on line graph.
- Step IV: Show how inequalities in two variables can be solve graphically.
- Step V: Explain the different regions in inequalities in two variable; say Region below the line, on the line and above the line Categorically.

Evaluation: 1. Show the region which satisfies simulations by the following Inequalities.

- a. $X + y < 2$
 $3x - y \geq 6$
- b. $4x - y \leq 10$
 $2x + 2y \leq 12$
 $Y \geq 0$

2, Solve the inequalities

- a. $X(x + 2) < 0$
- b. $(x + 3)(x - 2) \geq 0$.

LESSON 8

Subject: Mathematics

Class: SSII

Duration: Double periods of 40mins each

Average age: 16yrs

Topic: Algebraic processes

Objective: Students should be able to:

Simplify, factorize, expand and substitute into algebraic

Expression expressions and formulae.

Teaching aids: Chalk, chalkboard, ruler and textbook.

Instructional technique: Refer to teachers instructional guide

Instructional procedure:

- Step I: Explain the term algebraic expression. Discuss types of Algebraic expressions.
- Step II: Illustrate how to simplify an algebraic expression (collecting the Like terms).
- Step III: Show how algebraic expressions can be factorized.
- Step IV: Teach how Algebraic expression containing brackets can be expanded and the collection of like terms where possible.
- Step V: Explain how substitution can be carried out by reason of evaluation. The process of substituting into formulae should be treated thoroughly.
- Evaluation:
1. Simplify $2x^2 - 3ax + 4x^2 - 6xa - x^2$
 - 2, Remove bracket from the expression $-3(2x - 5y + 6z)$
 - 3, factorize $6 - 15x + 9x^2$

Lesson 9

Subject: Mathematics

Class: SS II

Duration: Double periods of 40mins each

Average age: 16yrs

Topic: Gradients and Lines

Objective: Students should be able to:

- i. Sketch or plot the graph of straight lines and curves.
- ii. Find the gradient of lines and curves.

Teaching aids: Chalk, chalkboard, and ruler.

Instructional technique: Follow the teacher's instructional guide

Instructional procedure:

- Step I: Define a straight line graph for a given function and discuss how Gradient of the line can be determined.

- Step II Plot a straight line graph for a given function and discuss how
The gradient of the line can be determined
- Step III: Instruct on how to find the gradient of a curve at a given point
on the curve.
- Step IV: Show how to get the equation of a straight line given the
Following:
I. One point and gradient
II. Two points
- Step V: Explain why the gradient of a line is constant along the line,
While that of a curve varies from point to point on the curve.
- Evaluation: 1. Find the equation of the following straight lines.
a. Gradient 3 and passes through point (2,1)
b. Gradient $-1/2$ and passes through point (-4, -5)
2. Calculate the gradient of the following pairs of points
i. (2,5) and (4,9)
ii. (-4,-9) and (-2,1).

Lesson 10

- Subject: Mathematics
- Class: SS II
- Duration: Double periods of 40mins each
- Average age: 16yrs
- Topic: Polynomials
- Objective: Students should be able to:
i. Perform operations on polynomials
ii. Determine the roots of a polynomials equations.
- Teaching aids: Chalk, chalkboard, textbook.
- Instructional technique: Follow the teacher's instructional guide
- Instructional procedure:
- Step I: Define polynomial. Explain the different types of algebraic
Expression i.e monomial, binomial, trinomial and polynomial.
- Step II: Perform the four basic mathematical operations using

Polynomials of different degrees.

Step III: Explain the technique of factor theorem and remainders Theorem.

Evaluation: 1. Solve the equation $6x^4 + 11x^5 - 28x^2 - 15x + 18 = 0$
2. divide $x^3 + 64$ by $x + 4$.

APPENDIX G

LESSON PLANS ON PROBLEM SOLVING METHOD

The role of the teacher in problem solving

- Moderate the motivation of the students.
- Encourage divergent thinking in students.
- Present the problem as a whole
- Moderate the difficulty level of the problem.
- Encourage students to practice on their own.
- Allow students to complete the solution to a problem

Problem solving process

There are plenty problem solving process. However, all processes cover basic steps which are familiar. Thus the study Polyas' methods (1945), which suggest that the teacher leads a discussion on every problem to help students solve it in the following steps.

1. Understand the problem (identify)
2. Device a plan (analyse)
3. Carryout the plan (generate discussion for the procedure)
4. Look back (evaluate)

LESSON 1

Subject:	Mathematics
Class:	SSII
Duration	Double period of 40 minute, each.
Average age:	16yrs
Topic:	Indices and logarithms
Objectives:	Students should be able <ol style="list-style-type: none">1. Use laws of indices in calculations2. Solve exponential equation3. Apply laws of theory of logarithms4. Use mathematics tables in calculations
Teaching aids:	Chalkboard, tables and textbook.
Instructional Techniques:	Refer to teacher's instructional guide above
Instructional procedure:	

- Step 1: To guide students to understand the problem, the teacher instructs the students to understand and memorize the laws of indices and Logarithms. He shows how these laws can be used in problem Solving; giving examples; thereby explaining how problems on Indices and logarithms can be solved.
- Step II: Introduce a method; the teacher does the same in step 1, but Evaluate where possible.
- Step III: Carryout the plan: The teacher further uses the laws of indices and logarithms to show how equation can be solved.
- Step IV: Look back or evaluate: the teacher generates discussion by asking the students to differentiate between the laws of Indices and the laws of logarithms
- Evaluation: The teacher instructs the students to perform the following exercise by
- i. Identifying the laws
 - ii. Analyzing their applications
 - iii. Carrying out work and
 - iv. Look back to comparing their difference
 1. Write down the difference between the practical laws of indices and the theoretical laws of logarithms.
 2. Explain how an index equation can be changed to logarithms equation by meaning of logarithm.

Lesson 2

Subject:	Mathematics
Class:	SSII
Duration:	Double periods of 40mins each
Average age:	16 years
Topic:	Surds
Objectives:	Students should be able to <ol style="list-style-type: none">Simplify surdsRationalize denominators of fractional surdsPerform operations on surds.
Teaching aids:	Chalk, Chalkboard and textbook
Instructional technique:	Refer to teacher's instructional guide:
Instructional procedure:	
Step: 1	The teacher teaches the students the meaning of surds, rational numbers, irrational numbers and perfect squares
Step 2:	The teacher guides the students to define rational number and irrational numbers with examples. <ol style="list-style-type: none">A rational numbers is a number that can be expressed as a fraction. For example 2, $\frac{2}{3}$, 4, 6, $\frac{7}{8}$ are rational numbersAn irrational numbers is a number that can be expressed as a fraction. For example $\sqrt{2}$, $\sqrt[2]{3}$, π are irrational numbers
Step III:	The teacher generates discussion that would enable the students discover that following term and mathematical truths: <ol style="list-style-type: none">The square root of perfect squares are whole numbers

- ii. The square root of non- perfect squares are not whole numbers, they are called irrational numbers.
- iii. To rationalize a surd: means to make the surd rational

Evaluation: The teacher asks the students to use the knowledge of conjugate surds to rationalize surds.

Lesson 3

Subject: Mathematics

Class: SSII

Duration: Double period of 40munis each

Average: 16 years

Topic: Probability.

Objectives: Students should be able to

- i. Define probability
- ii. Solve problems on probability.
- iii. Understand hope to play probability games and possible simulations.

Teaching aids: Chalkboard, coins, dice, and playing cards (poker).

Instructional technique: Refer to teacher’s instructional guide:

Instructional Procedure:

Step I: To guide the students to understand probability games and simulations.

Step II: The teacher plays the probability games with the Students such as: tossing a coins, throw of die or dice and card games.

Step III: The teacher guide the students to perform simulations using the instructional materials as listed in step II.

Step IV: The teacher asks the students to shows the outcomes from probability games for example.

- i. When a coin is tossed; the outcome is either a HEAD OR TAIL
- ii. When a die is rolled, the outcome of any number is equally, because the faces of the die are number from 1 to 6.
- iii. When a card is picked at random from a pack or deck of well- shuffled 52 cards, the outcomes that are possible are analyzed.

Evaluation:

The teacher asks the students to find the probability of the following:

- i. The probability of getting a head when a coin is tossed.
- ii. The probability of getting a double number when two dice are thrown once.
- iii. The probability of picking a red card from a pack of 52 well-shuffled playing cards.

Hint:

probability of event (A) =

$\frac{\text{No of favorable outcomes}}{\text{Total no of outcomes in the sample space.}}$

Thus, $P(A) = \frac{n(F)}{N(S)}$

Where $P(A)$ = prob of event $n(S)$; $n(F)$ = no of favourable outcome of elements in the sample space.

LESSON 4

Subject:

Mathematics

Class:

SS II

Duration:

Double period of 40 minutes each.

Average Age:	16years
Topic:	Sequences and Series
Objective:	Students should be able to: <ul style="list-style-type: none"> i. Identify a sequence; ii. Find the nth term of a sequence; iii. Find the sum of finite series iv. Solve problem on sequences and finite series.
Teaching Aid:	Chalk, chalkboard and textbook
Instructional procedure:	
Step I:	Teacher guides the student to identify a sequence and say whether it is an arithmetic progression or a geometric progression.
Step II:	Teacher generates discussion on (i) the formula for the nth term of a sequence: $T_n = a + (n-1)d$A.P. and $T_n = ar^{n-1}$G.P. (ii) Sum of n terms of a sequence: $S_n = n/2 [a+b]$ finite sequence. or $S_n = n/2 [2a+(n-1)d]$finite sequence. $S_n = \frac{a(1-r^n)}{1-r}; r < 1$ And $S_n = \frac{a(r^n - 1)}{r-1}; r > 1$
Step III:	Teacher solves problems using the formulae stated in step II.
Evaluation:	Differentiate between the formula for sum of n terms of a G.P series for sum to infinite of a G. P series.

LESSON 5

Subject:	Mathematics
Class:	SSII
Duration:	Double period of 40mins each.
Average age:	16years
Topic:	Literal equations and quadratic functions
Objective :	Students should be able to: <ol style="list-style-type: none">Solve simple equationsSolve quadratic equationsSolve word problems leading to both simple and quadratic equation
Teaching aids:	Chalkboard, and textbook
Instructional Technique:	Refers to teacher's guide
Instructional procedure:	Refer to teachers guide. Instructional
Step I	Teacher defines a literal equations and show how quantities are related in a formula.
step II:	Teacher solves problems on simple equations and quadric equations, Thus: solve <ol style="list-style-type: none">$2x - 8 = 0$$X^2 - 5x + 6 = 0$$Y + 8 = 0$$X^2 - 9 = 0$ The teacher instructs the students on different methods of solving a quadratic equation: namely: <ol style="list-style-type: none">Complete the square methodQuadratic formula methodGraphical method (solution)Factorization method.
Step III:	The teacher solves the equations in step II. Viz: <ol style="list-style-type: none">$2x - 8 = 0$ $2x = 8$

$$\therefore X = 4$$

$$\text{ii, } x^2 - 5x + 6 = 0$$

$$X^2 - 3x - 2x + 6 = 0$$

$$X(x - 3) - 2(x - 3) = 0$$

$$(x - 3)(x - 2) = 0$$

$$(x - 3)(x - 2) = 0$$

$$\text{Either } x - 3 = 0, x = 3 \text{ or } x - 2 = 0, x = 2$$

$$\text{iii, } Y + 8 = 0$$

$$\therefore Y = -8$$

$$\text{v. } X^2 - 9 = 0$$

$$X^2 = 9$$

$$X =$$

$$\pm \sqrt{9}$$

$$\therefore X = \pm 3.$$

Evaluation:

The teacher asks the students to solve the

Equation $X^2 - 5x + 6 = 0$ using the four methods

Mentioned in step II.

LESSON 6

Subject:

Mathematics

Class:

SS II

Duration:

Double period of 40 mins each .

Average:

16yrs

Topic:

Change of subject and variations.

Objective:

Student should be able to:

- i. Change the subject of formula
- ii. Solve problem on change of subject
- iii. Use the knowledge of change of subject to solve problems on variations.

Teaching aids:

Chalkboard, textbooks

Instructional procedure:

Step I: The teacher puts down equations in terms of Letters as examples of literal equations. For Example $A = Lb$ -- (1)
 $V = \frac{1}{3} \pi r^2 X h$ etc.
 Thus $V \propto r^2 h$ →

3

STEP I: Continued, type of variations are

- 1 Direct variation
- 2 Inverse variation
- 3 Joint variation
- 4 Partial variation

STEP II: The teacher uses the knowledge of change of subject to solve problems on variations.

1. If $C \propto n$ and $C = 5$ when $n = 20$,
 Find the formula connecting C and n .

Solution

$$C \propto n \Rightarrow C = Kn$$

$$C = kn$$

$$C = 5 \text{ when } n = 20$$

$$K = \frac{5}{20} = \frac{1}{4}$$

Thus $c = \frac{1}{4} n$ is the formula which connects C and n .

(11) if $M \propto L$ and $M = 6$ when $L = 2$, find

(a) the relationship between M and L ,

(b) the value of L when $M = 15$.

Solution

- a. If $M \propto L$, then $m = KL$ when $M = 6, L = 2$

$$\text{When } M = 6, L = 2$$

$$\text{Thus, } 6 = 2L$$

$$K = 3$$

$\therefore M = 3L$ is the relationship between M & L

(b) $M = 3L$

When $M = 15$

THUS, $15 = 3L$

$L = 5$

Step iii: The teachers instructs the students on how variation word problems can be put in form of mathematical models and their solution

Evaluation: Differentiate between the four types of variations mentioned in Step I (one).

LESSON 7

Subject: Mathematics

Class: SS II

Duration: Double period of 40mins each.

Average age: 16 years.

Topic: Inequalities

Objective: Students should be able to:

- i. Solve problems on inequalities in one variable
- ii. Represent solution sets on a number line,
- iii. Solve problems on linear inequalities in two variables.
- iv. Apply linear inequalities to linear, programming and Optimization.

Teaching aids: Chalk, chalkboard, graphs and textbook.

Instructional techniques: Refer to teachers guide instructional procedure:

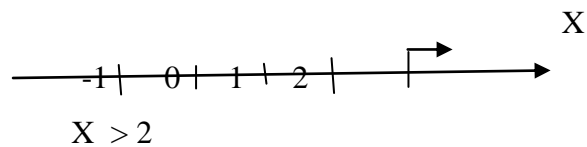
Step I: Teacher solves problem on line inequalities in one variable:

If (a) $2x > 4$: solve and represent the solution on a number line,

$2x > 4$

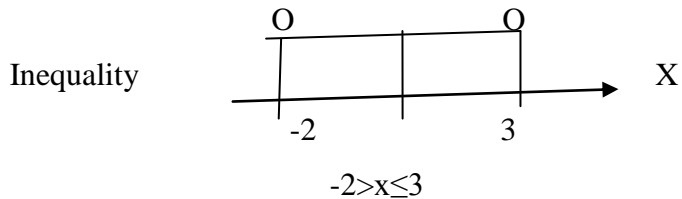
$x > 4/2$

$x > 2$



(b) Represent $-2 > x \leq 3$

On a number line show how to represent the above



Step ii: The teacher instructs the students on how to solve graphically problems of inequalities in two variables. The teacher solves and show the students three distinct inequality regions.

LESSON 8

Subject: Mathematics

Class: SS II

Duration: Double period of 40mins each.

Average age: 16 years.

Objective: Students should be able to:

- 1 Use letters to express numbers.
- 2 Express basic arithmetic processes
- 3 Substitute numbers for words letters in formulae.
- 4 Use brackets and extract common factors.
- 5 Expand and factorize algebraic expression.

Teaching aids: Chalkboard and Textbook

Step I: To guide the students to understand algebraic processes. The teacher instructs the students to use the skill of expansion and factorization to handle problems on algebraic processes.

Step ii: The teacher does the expansion and factorization of algebraic expression.
Thus:

i. Simplify $2x^2 - 3ax + 4x^2 - 6ax - x^2$
 $\Rightarrow 2x^2 + 4x^2 - x^2 - 3ax - 6ax = 5x^2 - 9ax.$

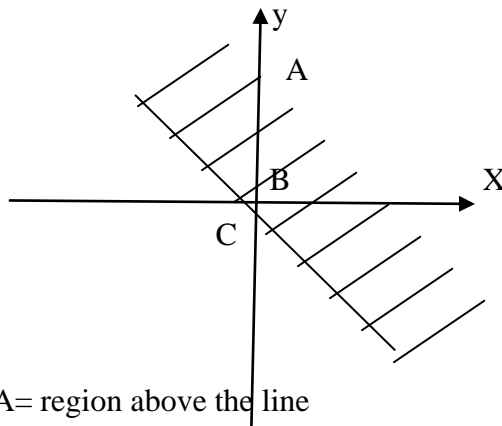
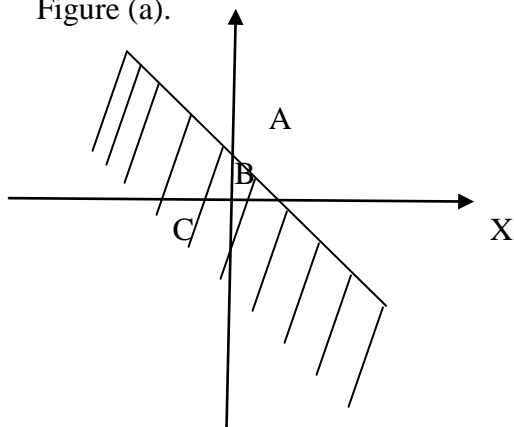
ii. Remove bracket from the expression
 $3(2x - 5y + 6z) = -6x = 5x^2 - 9ax.$

iii. Factorize the expression. $X^2 - 5x + 6$
 $\Rightarrow X^2 - 5x + 6 = (x - 3)(x - 2).$

Considering the sketches below for problem on inequalities in two variables say X and Y,

(a)

Figure (a).



A= region above the line

B= points on the line included in the Solution set.

In fig 1(b)

A = shaded region(required) to satisfy the

Given inequality

B = Broken line, means that points on

The line are not included in

Solution set.

C = points below the line, i.e region

That does not satisfy the

Given inequality.

Evaluation: solve the following set of simultaneous inequalities: $y \geq 0$

$$x - y \geq 1,$$

$$4x + 3y \leq 12.$$

Step iii

The teacher engages the students on different operations on algebraic processes, such as:

Simplification, expansion,

Factorization and

Evaluation by substitution

Step iv:

Teacher teaches the students how to substitute the Values of variable to get the value of any given algebraic Expression. For example if

A= 2, b=-3 and c=8 evaluate

(1) $\frac{ab}{c}$

(2) $\frac{a^2 b}{c}$

c

Solution: given a=2, b=-3 and c=8

(1) Then $\frac{ab}{c} = \frac{2(-3)}{8}$

$$= \frac{-6}{8}$$

$$= -\frac{3}{4}$$

8

$$\therefore \frac{ab}{c} = -\frac{3}{4}$$

$$C \quad 4$$

$$\begin{aligned}
 (2) \frac{a^2 b}{c} &= \frac{(2)^2 (-3)}{8} \\
 &= \frac{4(-3)}{8} \\
 &= \frac{-12}{8} \\
 &= \frac{-3}{2} \\
 \text{Or } &1 \frac{1}{2}.
 \end{aligned}$$

Evaluation:

1. Write as a single fraction

$$\frac{5}{6r} - \frac{3}{4r}$$

2. Simplify $\frac{x}{x-3} - \frac{x-1}{x+2}$

LESSON 9

Subject: Mathematics

Class: SSII

Duration: Double period of 40mins each.

Average age: 16 yrs

Topic: Gradients and lines

Objective: Students should be able to:

- i. Determine the gradient of a straight line
- ii. Gradient of a curve at a given point
- iii. Solve problems on coordinate rectangular geometry

Teaching aids: Chalk, chalkboard and ruler, graphs and textbook

Instructional technique: Refer to teachers instructional guide

Instructional procedure:

- Step I: Teacher teaches the idea of the slope of a line (gradient).
He defines the meaning of a straight line i.e, the shortest distance between two points.
- Step II: Teacher instructs the students on how to get the equation of Straight line given one point and gradient (point –slope) form of a straight line; thus, $Y = mx + C$
Where $Y =$ dependent variable
 $M =$ gradient of the line.
 $X =$ independent variable * intercept on y $C =$ constant term.
How to write the equation of a straight line given two points; thus:

$$\frac{Y - Y_1}{X - X_1} = \frac{Y_2 - Y_1}{X_2 - X_1}$$

Where (x_1, y_1) and (x_2, y_2) are the two points.

- Step III: guide the student to determine the slope (gradient) of a line Using geographical method.
Thus, gradient $M = \frac{\text{vertical change}}{\text{Horizontal change}}$

$$\Rightarrow M = \frac{y_2 - y_1}{x_2 - x_1}$$

Where (X_1, Y_1) and (X_2, Y_2) are the coordinates of the two Points.

Show how the gradient of a curve can be determined.

- Step IV: Instructs on how to calculate distance between two points, say pts: A and B.

Given that pt. A (3, - 2) and B (-4, 5).

Let $d =$ distance between A and B

$$\begin{aligned} \text{Then } d &= \sqrt{(x_2 - x_1)^2 + (Y_2 - Y_1)^2} \\ &= [(-4 - 3)^2 + [5 - (-2)]^2]^{1/2} \\ &= \sqrt{49 + 49} \\ &= \sqrt{49+2} \\ \therefore D &= 7\sqrt{7} \text{ units.} \end{aligned}$$

Evaluation:

1. Find if AB is paralleled or perpendicular to PQ in the Following case. A (4,3), B (8, 4) and P (7, 1), Q (6, 5)
2. Find the equation of a straight line which passes through (- 4, 3) and is parallel to line $Y = 2x + 5$.

Lesson 10

Subject: Mathematics

Class: SSII

Duration: Double periods of 40mins each.

Average age:

Topic: Polynomials

Objective: Students should be able to:

- i. Identify a polynomial
- ii. Manipulate a polynomial under operations of addition subtraction, multiplication and division.
- iii. Factorize polynomial of degree less than or equal to four(4).
- iv. Find roots of polynomial equations (functions).
- v. Plot graphs of polynomials equations (functions)
- vi. Solve polynomial equations by graphs.

Teaching aids: chalk, chalkboard, graphs, charts, (table of values) and Duster.

Instructional technique: Refer to the teachers instructional guide:

Instructional procedure:

Step I: The teacher instructs the students on how to identify a Polynomial. He gives examples on types of algebraic Expressions; i.e monomial, binomial, trinomial and Polynomial.

Step II: The teacher performs operations with polynomials e.g Addition, subtraction, multiplication and division.

Step III: He/she discusses the concept of factor theorem and remainder Theorem.

Step IV:

The teacher solves problems on polynomials. For example

1. Find the remainder when $x^3 + 6x^2 - x - 30$ is divided by $(x + 1)$.

Solution: given $(X^3 + 6x^2 - x - 30) \div (x + 1)$

$$X + 1 = 0 \quad X = -1$$

$$\text{Then } F(-1) = (-1)^3 + 6(-1)^2 - (-1) - 30 = -24$$

$$\text{Thus, } f(-1) = 24$$

When $X^3 + 6x^2 - X - 30 \div (x + 1)$ the remainder is -24 .

2. Show that $(x - 3)$ is a factor of $X^3 - 4x^2 + X + 6$ and hence find the other factors of the expression.

Solution: given $X^3 - 4x^2 + X + 6$; to show that $(X - 3)$ is a factor of the above expression.

$$F(x) = X^3 - 4x^2 + x + 6 \quad \text{set } x - 3 = 0$$

$$X = 3$$

$$F(3) = 0$$

Hence $(x - 3)$ is factor of $x^3 - 4x^2 + x + 6$.

3. Multiply $7x^3 - 5x^2 + 4x - 9$ by $x^2 + 6x - 4$.

Solution: $(7x^3 - 5x^2 + 4x - 9)(x^2 + 6x - 4)$

$$\Rightarrow 7x^5 + 37x^4 - 61x^3 + 40x^2 - 74x + 45.$$

4. Divide $x^4 - 6x^3 - 6x^2 + 54x - 27$ by $x + 3$

$$\underline{X^3 - 9x^2 + 21x - 9}$$

$$x+3 \sqrt{x^4 - 6x^3 - 6x^2 + 54x - 27}$$

$$\underline{x^4 + 3x^3}$$

$$- \quad \underline{9x^3 - 6x^2}$$

$$- \quad \underline{9x^3 - 27x^2}$$

$$\underline{21x^2 + 54x}$$

$$\underline{21x^2 + 63x}$$

$$- \quad \underline{9x - 27}$$

$$- \quad \underline{(-9x - 27)}$$

$$\underline{0}$$

$$\text{Thus: } \underline{x^4 - 6x^3 - 6x^2 + 54x - 27}$$

$$X + 3$$

$$\implies X^3 - 9x^2 + 4x - 9$$

Evaluation:

1. Divide $x^3 + 64$ by $x + 4$

2. Solve the equation

$$6x^3 + x^2 - 19x + 6 = 0$$

3. Plot the graph of $f(x) = 2x^2 - 5x + 2$

$F(x) = 2x^2 - 5x + 2$. Take the range of values of x from -5 to 6 .

APPENDIX H

LESSON PLANS FOR STUDENT CENTERED LEARNING STRATEGY

Teachers' guide for student centered learning strategy.

Student centered concentrates on students' needs abilities and interest with only the teachers as a facilitator of learning. To make lesson student centered approach. Attention must be given to the following aspects:

1. Use concrete instructional aids
2. Organize activity based instruction.
3. Encourage group activities
4. Allow student s interaction through independent work.
5. Encourage asking questions.

Lesson 1

Subject: Mathematics

Class: SSII

Duration: double period of 40mins each

Average age: 16yrs

Topic: Indices and logarithms

Objective: Students should be able to:

- i. Use laws of indices in calculations,
- ii. Solve problems on exponential equations with the aid of laws of indices;
- iii. Apply laws of theory of logarithms in problem solving and
- iv. Use logarithms tables in calculations.

Teaching aids: Chalkboard, mathematical and textbook.

Instructional technique: Refer to teachers instructional guide:

Instructional procedure:

Step I: Define indices and logarithms of numbers. Use prime factors to Show how a number (s) can be put in index form.

Step II: Show how to use tables of logarithms and anti-logarithms.

Step III: Demonstrate in a tabular form how logarithm work can be set

Out (format for logarithm work).

Step IV: Explain the laws and rules of logarithms with examples.

Evaluation: 1. What is the difference between the index of a number and
The logarithm of a number.

2, (i) Given: $2^x = 8$ show that $x = 3$

(ii) Simplify the following without using tables

a. $\frac{\log 4}{\log 2}$

$\log 2$

b. $\log \frac{243}{\log 3}$

$\log 3$

c. $\frac{\log 0.2}{\log 25}$

$\log 25$.

Lesson 2

Subject: Mathematics

Class: SSII

Duration: Double period 40mins each.

Average age: 16yrs

Topic: Surds.

Objective Students should be able to:

i. Simplify surds

ii. Rationalize surds:

iii. Carry out operations involving surds.

Teaching aids: Chalkboard and textbook

Instructional technique: Follow the guide

Instructional procedure:

Step I: Explain the following; surds, irrational numbers, perfect square
And non-perfect squares.

Step II: Use the algebraic identify of different of two squares to show
How two conjugate surds can be multiplied e.g $(\sqrt{a} + \sqrt{b})(\sqrt{a} - \sqrt{b})$.

step III: Show how rationalization of the denominators of fractional

Surds can be achieved.

Step IV: Show how trigonometrical ratios of special angles can be put in Surd form and rationalized where possible

$$\text{e.g } \frac{1 + \cos 30^\circ}{1 - \cos 30^\circ} = 1 + \sqrt{3} \frac{\frac{1}{2}}{\frac{1 - \sqrt{3}}{2}}$$

Evaluation: 1. Simplify the following

i. $\sqrt{8} + \sqrt{18} - \sqrt{24}$

ii. $\sqrt{25} - \sqrt{75} + \sqrt{5}$

2, rationalize the following

i. 6

~~$\frac{2\sqrt{2}-1}{2}$~~

ii. $\frac{2\sqrt{3}+2}{2\sqrt{3}-2}$

$2\sqrt{3}-2$

LESSON 3

Subject: Mathematics

Class: SSII

Duration: Double period of 40mins each.

Average age: 16yrs

Topic: Probability.

Objective: Students should be able to

i. Explain probability of an event.

ii. Calculate the probability of an event.

iii. Solve problems on probability.

Teaching aids: Chalkboard, poker cards, die, dice and coins.

Instructional technique: Refer to Teachers

Instructional guide:

Instructional procedure:

Step I: Describe the concept of probability

- Step II: Explain experimental probability by reason of games and Simulations
- Step III: Engage the students in playing probability games for further understanding of the concept of probability.
- Step IV: Explain the meaning of ‘OR’ and ‘AND’ in probability operations.
- Step V: Use step IV to discuss mutually exclusive events and independent events.
- Evaluation: 1. Find the probability that a number chosen at random from the integers between 10 and 20 is either a prime or a multiple of 3.
2. In a game a fair dice is rolled once and two unbiased coins are tossed once. What is the probability of getting 3 and a tail?

LESSON 4

- Subject: Mathematics
- Class: SSII
- Duration: Double periods of 40mins each.
- Average age: 16 yrs
- Topic: Sequences and series
- Objective: Students should be able to:
- i. Identify a sequence:
 - ii. Find the nth term of a sequence
 - iii. Find the sum of finite series
 - iv. Solve problems on sequences and finite series.

Teaching aids: Chalkboard, duster and textbook

Instructional technique: Refer to teachers instructional guide:

Instructional procedure:

- Step I: Explain the following terms:
- i. Sequence
 - ii. Series.
 - iii. Arithmetic progression.
 - iv. Geometric progression.
- Step II: Show how a sequence can be put in a tabular form algebraically
- Step III: Show how to generate general arithmetic progression on

Geometric progression.

Step IV: Show the formulae that are involved in sequences and series.

Step V: Teach the students how the formulae contained in step IV can Applied in calculations.

Evaluation: 1. The sum of the first 9 terms of an A. P is 72 and the sum of the Next 4 terms is 71. Find the A.P

2, The common ratio of a S.P is 2. If the 5th term is greater than The first term by 45; find the 5th term.

Lesson 5

Subject: Mathematics

Class: SS II

Duration: Double period of 40mins each.

Average age: 16 yrs

Topic: Literal equations and quadratic functions/equations.

Objective: Students should be able to:

- i. Solve problems on literal equations
- ii. Substitute into formulae
- iii. Solve problems on simple linear equations and quadratic equations.

Teaching aids: Chalkboard, chalk, textbook

Instructional technique: follow the guide instructional procedure:

Step I: Explain the difference between functions and equation.

Step II: show how the variable in a literal equations can be calculated.
Explain the methods used in solving simple equations in one Variable and quadratic equations.

Step III: instruct the students on the skill of factorization and completing The square method of solving quadratic equations.

Step IV: show the types of roots of a quadratic equations.

Evaluation: 1. Use the quadratic formula to solve the following equations.

i. $X^2 + 5x + 6x = 0$

ii. $12b^2 - 35b = 0$

iii. $15p^2 + P = 1$

2, solve the following equations by the method of factorization

i. $X^2 - 7x + 10 = 0$

ii. $2x^2 - 3x - 5 = 0$

Evaluation: (1) show the region which satisfies simultaneously

The following inequalities

a. $X + y < 2$

$3x - y \geq 6$

b. $4x - y \leq 10$

$2x + 2y \leq 12$

$Y \geq 0$

2, solve the inequalities

a. $X(x + 2) \leq 0$

b. $(x + 3)(x - 2) \geq 0$

Lesson 6

Subject: Mathematics

Class: SSII

Duration: Double periods of 40mins each

Average age: 16yrs

Topic: Change subject and variations

Objective: Students should be able to:

i. Make a required variable subject of the formulae

ii. Solve problems on variations with the idea of change of subject.

iii. Solve problems on change of subject.

Teaching aids: Chalk, chalkboard, ruler and textbook

Instructional technique: Refer to teachers guide

Instructional procedure:

Step I: Show what formula is in relation to literal equation.

Step II: Show the use of change of subject to solve problems on variations.

Step III: Explain the different types of variations.

Step IV: Show how to put different types of variation problems into mathematical models (equations).

Step V: Engage the students in practicing the change of subject of the formulae.

Evaluation:

- i. Make y the subject of the formula if $a = c(1+y)$.
- ii. The volume V of a cone of height h and base r is given by the formula $V = \frac{1}{3} \pi r^2 h$
 - a. Change the subject of the formula to r
 - b. Calculate the base radius of a cone of height 14cm and volume 33cm^3 taking $\pi = \frac{22}{7}$
- iii. P varies directly as the square of Q . if $P = 27$ when $Q = 6$. Find the equation relating P and Q . find P when $Q = 10$ and Q when $P = 18 \frac{3}{4}$

Lesson 7

Subject: Mathematics

Class: SS II

Duration: Double periods of 40 minutes each.

Average Age: 16years

Topic: Inequalities

Objective: Students should be able to:

- i. Solve problems on inequalities.
- ii. Represent solution sets of inequalities on a number line (i.e. line graph).
- iii. Solve graphical inequalities in two variables, say x and y

Teaching Aid: Ruler, Graph, Chalkboard.

Instructional Techniques: Follow the guide.

Instructional Procedure:

Step I: Define the term inequality.

Step II: Explain the use of inequality signs and symbols.

- Step III: Show how to represent solution sets of linear inequalities.
- Step IV: Teach how to solve graphically inequalities in two variables.
- Evaluation:
- i. Show the region which satisfies simultaneously, the following inequalities:
 - a. $x + y < 2$
 $x - y \geq 6$
 - b. $4x - y \leq 10$
 $2x + 2y \leq 12$
 $y \geq 0$
 - ii. Solve the inequalities
 - a. $X(x+2) \leq 0$
 - b. $(x+3)(x-2) \geq 0$

Lesson 8

- Subject: Mathematics
- Class: SSII
- Duration: Double periods of 40mins each
- Average age: 16yrs
- Topic: Algebraic processes
- Objective: Students should be able to
- i. Simplify algebraic expressions.
 - ii. Expand algebraic expressions
 - iii. Substitute variables into algebraic expressions and formulae
- Teaching aids: Chalk, chalkboard, ruler and textbook.
- Instructional technique: Refer to teachers instructional guide
- Instructional procedure:
- Step I: Show typical examples of algebraic expressions. Instruct on type Of algebraic expressions.
- Step II: Impact the knowledge of simplifying algebraic expressions

- Step III: Demonstrate the factorization and expansion of algebraic Expressions
- Step IV: Show substitutions in algebraic expressions with examples.
- Evaluations: 1. Simplify $2x^2 - 3ax + 4x^2 - 6ax - x^2$
 2, Remove bracket from the expression $-3(2x - 5y + 6z)$.
 3, factorize $6 - 15x + 9x^2$

Lesson 9

- Subject: Mathematics
- Class: SSII
- Duration: Double periods of 40mins each
- Average age: 16yrs
- Topic: Gradients of lines/curves
- Objective: Students should be able to:
- i. Find the gradient of lines and curves;
 - ii. Sketch/plot the graph of straight lines and curves.
- Teaching aids: Chalk, chalkboard, ruler and textbook.
- Instructional technique: refer to teachers guide.
- Instructional procedure:
- Step I: Explain what a straight line is.
- Step II: Show a straight line function and how to plot the graph of a Straight line.
- Step III: Show how to determine the gradient of straight lines and curves
- Step IV: explain the difference between the gradient of a straight line And that of a curve.
- Evaluation: Find the equation of the following straight lines.
- a. Gradient 3 and passes through point (2,1)
 - b. Gradient $-\frac{1}{2}$ and passes through (-4,-5)
- Calculate the gradient of the following pairs of points.
- i. (2,5) and (4, 9)
 - ii. (-4, -9) and (-2, 1).

Lesson 10

Subject:	Mathematics
Class:	SSII
Duration:	Double periods of 40mins each
Average age:	16yrs
Topic:	Polynomials.
Objective:	Students should be able to: iv. Perform operations on polynomials v. Determine the roots of polynomial equations
Teaching aids:	chalk, chalkboard, textbook
Instructional technique:	Refer to teachers guide
Instructional procedure:	
Step I:	Explain what a polynomial is.
Step II:	Give examples on types of polynomials
Step III:	Perform operations on polynomials; e.g addition, subtraction, Multiplication and division.
Step IV:	Explain the ideal of factor theorem and remainders theorem.
Evaluation:	1. Solve the equation $6x^4 + 11x^5 - 28x^2 - 15x + 18 = 0$ 2, Divide $x^3 + 64$ by $x + 4$.

APPENDIX I

ALGEBRAIC TEST QUESTION (ATQ)

Instruction: Tick the correct answer t each question.

- Expand $(x + 8)(x + 5)$
(a) $X^2 - 8x + 4x + 40$ {b} $X^2 + 6x - 4x + 20$
{c} $X^2 + 8x - 5x + 20$ {d} $X^2 + 8x + 5x + 40$
- What is the value of $\frac{p - q}{p}$ when $p = -5$, $q = +10$
(a). -3 (b). 4 (c). 3 (d). -4
- Simplify $2x^2 - 3ax + 4x^2 - 6xa - x^2$
(a). $6x^2 - 9ax$ (b). $5x^2 - 8ax$ (c). $5x^2 - 9ax$ (d). $4x^2 - 9ax$
- Factorize $10x^2 + 5x - 2x - 1$
(a). $(2x + 1)(5x - 1)$ (b). $(3x + 1)(5x - 1)$
(c). $(4x - 1)(6x + 2)$ (d). $(3x + 1)(5x - 1)$
- Solve $2x - 8 = 0$
(a). -4 (b). 4 (c). -2 (d). -5
- Solve the quadratic equation $x^2 - 7x + 10 = 0$
(a). $x = 2$ or 7 (b). $x = 5$ or 2 (c). $x = -5$ or 2 (d). $x = 5$ or -2
- The lengths of the three sides of a triangle are given by x , $x - 4$ and $x + 3$. If the perimeter is 20. Find the value of x
(a) 8 (b) 9 (c). 10 (d) 7
- When a number is multiply by 4, the result is the same as that of adding 30 to 2 times the number. Find the number.
(a). 20 (b). 30 (c). 25 (d). 15
- Solve the simultaneous equations
 $X/2 + y = 1/2$ and $X - y/2 = -5/2$
(a). $x = -2$ and $y = 4$ (b). $x = 3$ and $y = -2$
(c). $x = -2$ and $y = 1$ (d). $x = 3$ and $y = 0$
- Solve the equation $x^{1/2} = 3$
(a). 9 (b) 10 (c). 12 (d) 4

11. Solve $5x = 80x^{-1/3}$
 (a) ± 8 (b) ± 4 (c) ± 2 (d) ± 1
12. Solve $4^x = 0.5$
 (a) 2 (b) -2 (c) $\frac{1}{2}$ (d) $-\frac{1}{2}$
13. Evaluate $625^{3/4}$
 (a). 5 (b). 25 (c). 125 (d). 20
14. Simplify $\sqrt{72} \times \sqrt{75}$
 (a). $25\sqrt{6}$ (b) $30\sqrt{6}$ (c). $25\sqrt{5}$ (d) $7\sqrt{6}$
15. Simplify $\sqrt{8} \div 4\frac{4}{\sqrt{2}}$
 (a). $2\sqrt{2}$ (b). $\sqrt{2}$ (c). $4\sqrt{2}$ (d). 1
16. Express as a surd with rational denominator $\frac{2}{\sqrt{5}}$
 (a). $3\frac{\sqrt{5}}{3}$ (b). $3\sqrt{5}$ (c). $2\frac{\sqrt{5}}{5}$ (d). $\sqrt{5}$
17. Evaluate $(\sqrt{3} + \sqrt{2})(\sqrt{3} - \sqrt{2})$
 (a). 0 (b). 1 (c) -1 (d) 2
18. Given an arithmetic sequence 5,9,13,... find the 10th term of the A.P.
 (a) 42 (b) 43 (c). 41 (d) 46.
19. The 6th term of an A. P. is 35 and the 13th term is 77, find the first term.
 (a) 5 (b) 4 (c) 6 (d) -5
20. $\frac{8}{9}, \frac{4}{3}, 2, \dots$ Is a G. P. Find the 5th term.
 (a). $\frac{9}{2}$ (b). $\frac{4}{5}$ (c). $\frac{7}{8}$ (d). $3\frac{3}{9}$
21. Find the 10th term of an A.P given by $\frac{n}{n+2}$ as the nth term.
 (a). $\frac{1}{2}$ (b). $\frac{3}{4}$ (c). $\frac{5}{6}$ (d). $\frac{7}{8}$

22. Find the geometric mean of 3 and 48.
 (a) 144 (b) 12 (c) 49 (d) 7
23. Find the sum to infinity of the S.P series $\frac{1}{2} + \frac{1}{4} + \frac{1}{8} + \frac{1}{16} \dots$
 (a). 2 (b). 3 (c). -2 (d) 1
24. If $P \propto R$ and $P = 10$ when $R = 6$ find the relationship between P and R. Hence find R when $P = 12.5$
 (a). 7 (b) 8 (c) 9 (d) 7.5
25. Given that N varies inversely as D^3 and that $N = 240$ when $D = 3$, find N when $D = 2$
 (a). 710 (b) 200 (c) 90 (d) 810.
26. If y varies directly as \sqrt{m} and $y = 9$ when $m = 9$ find y when $m = 1\frac{7}{9}$
 (a) 2 (b) 3 (c) 8 (d) 4.
27. X varies directly as Y and inversely as Z. when $X = 5$, $Y = 2$ and $Z = 1$. What is the value of X when $Y = 5$ and $Z = 2$?
 (a). 2.5 (b). 5.0 (c). 6.25 (d). 7.5
28. Given that $x^2 + y^2 + k = 60$ and $x = \sqrt{10}$ when $y = 4$, find the value of k.
 (a) +34 (b) 38 (c) -24 (d) -56.
29. What is the probability of getting a double number when two dice are rolled once?
 (a) $\frac{1}{2}$ (b). $\frac{1}{6}$ (c). $\frac{1}{3}$ (d). $\frac{1}{12}$
30. In a pack of well shuffled 52 play cards, what is the probability of getting an ace at random picking?
 (a). $\frac{1}{12}$ (b). $\frac{1}{13}$ (c). $\frac{3}{13}$ (d). $\frac{1}{12}$
31. A single card is drawn from a deck of cards. It is then replaced and a second card is drawn. What is the probability that both cards are aces?
 (a) $\frac{1}{169}$ (b). $\frac{1}{52}$ (c). $\frac{4}{169}$ (d). $\frac{3}{52}$
32. A dice is tossed what is the probability of tossing a 5?
 (a) $\frac{1}{6}$ (b) $\frac{1}{5}$ (c). $\frac{1}{4}$ (d). $\frac{2}{5}$

33. Suppose a box contains 4 red balls and 5 white balls of the same shape and size. If two balls are selected at random from the box one after the other, the first being replaced before the second is picked. Determine the probability of obtaining two reds.

- (a). $\frac{8}{81}$ (b). $\frac{3}{89}$ (c). $\frac{16}{81}$ (d). $\frac{16}{71}$

34. What are the roots of the equation $x^2 - 5x + 6 = 0$

- (a). 1, 2 (b) - 1, 2 (c) 2, 3 (d). -3, 2

35. Divide $x^2 + 64$ by $x - 3$

- (a). $x^2 + 2x + 9$ R.91 (b). $x^2 + 3x + 9$ R. 91
(c). $x^2 + 3x - 9$ R.91 (d). $x^2 - 2x + 9$ R.91

36. Add $3x^2 - 7x + 8$ to $7x^2 + 4x - 5$

- (a). $10x^2 + 3x + 3$ (b). $8x^2 - 3x + 3$
(c). $7x^2 + 3x - 3$ (d). $10x^2 - 3x + 3$

37. Find the remainder when $4x^3 - 5x + 4$ is divided by $2x - 1$

- (a). -2 (b). 3 (c). 4 (d). -2

38. Which of the following algebraic expression is the factor of

$$6x^4 + 11x^3 - 28x^2 - 15x + 18 = 0$$

- (a). $(x - 1)$ (b) $(x + 1)$. (c). $(x + 2)$ (d) $(x - 2)$

39. Given the arithmetic sequence 5, 9, 13, ... find the 10th term of the A. P.

- (a). 42 (b) 43. (c). 41 (d). 50.

40. Given $\frac{8}{9}, -\frac{4}{3}, 2, \dots$ find the 5th term

- (a). $\frac{9}{2}$ (b). $\frac{4}{5}$ (c). $\frac{7}{8}$ (d). $3\frac{8}{9}$

41. The 6th term of an A. P. is 35 and the 13th term is 77, find the first term.

- (a) 5 (b) 4 (c) 6 (d) -5

42. Find the 10th term of A.P given by $\frac{n}{n+2}$ as nth term.

- (a) $\frac{1}{2}$ (b) $\frac{3}{4}$ (c). $\frac{5}{6}$ (d). $\frac{7}{8}$

43. What is the 12th term of the G.P. 2, 14, 98, ...

- (a) $2(6^{10})$ (b) $3(6^{11})$ (c) $2(7^{11})$ (d) $4(7^{11})$.

44. Find the equation of the line that passes through the points (4,2) and (-2,3)

(a). $y = 6x + \frac{8}{3}$ (b). $y = +\frac{1}{5}x + \frac{7}{5}$ (c). $y = \frac{1}{6}x + \frac{8}{6}$ (d). $y = 6x$

45. Find the midpoint of the points (2,5) and (4,9).

(a) 3, 7 (b) -3, 4 (c) 3, -7 (d) 2,4

46. Find the range of values of x for which $5x - 4 > 11$

(a) $x < 3$ (b) $x > 3$ (c). $x > 5$ (d). $x < 1$

47. Given that x is an integer, find the value of x that are possible in the equation

$$7x + 13 < 2x$$

(a) $x < 2\frac{3}{5}$ (b) $x > -2\frac{3}{5}$ (c). $x < -2\frac{4}{5}$ (d). $x < -1\frac{2}{5}$

48. What is the gradient of the equation $3 - x + 2x = y$

- (a) 2.
- (b). -2
- (c). -3
- (d). 1

49. Find the gradient of the following points (2,5) and (4,9).

- (a). 3
- (b). 4
- (c). 2
- (d). -2

50. When a number is multiplied by 3 the answer is equal to 2 subtracted from the number.

What is the number.

- (a). -1 (b) 1 (c) 2 (d) -2

ANSWERS TO THE AQT

1D	11A	21C	31A	41A
2C	12B	22B	32C	42C
3C	13C	23D	33C	43C
4B	14B	24A	34C	44C
5B	15D	25C	35B	45C
6B	16C	26D	36D	46A
7D	17B	27C	37D	47B
8D	18C	28A	38B	48C
9C	19A	29B	39D	49D
10A	20D	30B	40D	50A

APPENDIX J

ALGEBRAIC RETENTION TEST (ART)

Instruction: tick the correct answer for each question.

1. What is the value of $\frac{p - q}{p}$ when $p = -5$, $q = +10$

- (a). -3 (b). 4 (c). 3 (d). -4

2. Expand $(x - 3)^2$

- (a). $x^2 - 6x + 6$ (b). $x^2 - 6x + 9$ (c). $x^2 + 6x + 9$ (d). $x^2 - 4x + 8$

3. Factorize $10x^2 + 5x - 2x - 1$

- (a). $(2x + 1)(5x - 1)$ (b). $(3x + 1)(5x - 1)$
(c). $(4x - 1)(6x + 2)$ (d). $(3x + 1)(5x - 1)$

4. Simplify $2[h - 3k + 3h] - 3[k - 2h + 2k]$

- (a) $-15k + 13h$ (b) $14h - 15k$
(c) $20k - 15h$ (d) $-120k - 15h$

5. Simplify $\frac{6 - X - X^2}{X^2 - 4}$

- (a). $-\frac{3+x}{x+2}$ (b). $\frac{3+x}{x+2}$ (c). $\frac{2+x}{-2+x}$ (d). None

6. Solve the simultaneous equation $3x + y = 1$, $2x - 3y = 8$

- (a). $x = 1$ and $y = 2$ (b). $x = -1$ and $y = 2$
(c). $x = 0$ and $y = 1$ (d). $x = 2$ and $y = 1$

7. Solve $\frac{y}{6} + 3 = \frac{5y}{3} + 1$

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

8. Solve the quadratic equation $x^2 - 7x + 10 = 0$

- (a). $x = 2$ or 7 (b). $x = 5$ or 2 (c). $x = -5$ or 2 (d). $x = 5$ or -2

9. The lengths of the three sides of a triangle are given by x , $x - 4$ and $x + 3$. If the perimeter is 20. Find the value of x

- (a) 8 (b) 9 (c). 10 (d) 7

10. When a number is multiply by 4, the result is the same as that of adding 30 to 2 times the number. Find the number.

- (a). 20 (b). 30 (c). 25 (d). 15

11. Solve $5x = 80x^{-1/3}$

- (a) ± 8 (b) ± 4 (c) ± 2 (d) ± 1

12. Evaluate $625^{3/4}$

- (a). 5 (b). 25 (c). 125 (d). 20

13. Simplify $\sqrt{8} \div \frac{4}{\sqrt{2}}$

- (a). $2\sqrt{2}$ (b) $\sqrt{2}$ (c) $4\sqrt{2}$ (d) 1.

14. Solve for x in $3^{2x} - 12(3^x) + 27 = 0$

- (a) $x = 2$ or 1 (b) $x = -2$ or 1 (c) $x = 4$ or 1 (d) $x = 0$ or 2

15. Simplify $3\sqrt{27} - \sqrt{48} - 2\sqrt{75} + \sqrt{108}$

- (a). $\sqrt{2}$ (b). $\sqrt{3}$ (c). $\sqrt{5}$ (d). $\sqrt{7}$

16. If $\sqrt{2} - \frac{1}{\sqrt{2}} = p\sqrt{2}$, find P.

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

17. Evaluate $(\sqrt{3})^5$

- (a) $3\sqrt{3}$ (b) $4\sqrt{3}$ (c) $9\sqrt{3}$ (d) $3\sqrt{6}$

18. Evaluate $(\sqrt{3} + \sqrt{2})(\sqrt{3} - \sqrt{2})$

- (a) -0 (b) 1 (c) -1 (d) 2

19. Solve $4^x = 0.5$

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

20. Simplify by rationalizing the denominator of $\frac{3}{\sqrt{5} + \sqrt{2}}$

- (a) $3\sqrt{3} - \sqrt{3}$ (b) $\sqrt{5} + \sqrt{2}$ (c) $\sqrt{5} - \sqrt{2}$ (d) $\sqrt{3} - \sqrt{2}$

21. Find the value of $\log_7 12$ to two decimal places

- (a) 1.28 (b) 2.27 (c) 2.28 (d) 1.37

22. Simplify $\log_2 2^{\frac{1}{2}}$

- (a) 1 (b) 2 (c) 3 (d) -1

23. Simplify $\log_{10} 0.01$

- (a) 2 (b) -2 (c) 3 (d) -3

24. Find the distance between point A(2,3) and point A(6,5).

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

25. Obtain the midpoint of the segment joining the following points (3, 7) and (-1, 1)

- (a) (2,4) (b) (-1,4) (c) (1,4) (d) (1,-4)

26. Obtain the angle of inclination of the line that passes through the points (1,1) and (3,3).

- (a) 45^0 (b) 30^0 (c) 48^0 (d) 40^0

27. If $P \propto R$ and $P = 10$ when $R = 6$ find the relationship between P and R .
- (a). 7 (b) 8 (c) 9 (d) 7.5
28. Given that N varies inversely as D^3 and that $N = 240$ when $D = 3$, find N when $D = 2$
- (a). 710 (b) 200 (c) 90 (d) 810.
29. Find the 10th term of A.P given by $\frac{n}{n+2}$ as n^{th} term.
- (a) $\frac{1}{2}$ (b) $\frac{3}{4}$ (c). $\frac{5}{6}$ (d). $\frac{7}{8}$
30. Find the geometric mean of 5 and 48
- (a). 144 (b). 12 (c). 49 (d). 7
31. A single card is drawn from a deck of cards. It is then replaced and a second card is drawn. What is the probability that both cards are aces?
- (a) $\frac{1}{169}$ (b). $\frac{1}{52}$ (c). $\frac{4}{169}$ (d). $\frac{3}{52}$
32. Suppose a box contains 4 red balls and 5 white balls of the same shape and size. If two balls are selected at random from the box one after the other, the first being replaced before the second is picked. Determine the probability of obtaining two reds.
- (a). $\frac{8}{81}$ (b). $\frac{3}{89}$ (c). $\frac{16}{81}$ (d). $\frac{16}{71}$
33. A bag contains 2 blue balls; 3 red balls and 4 white balls. What is the possibility of picking a white balls at random?
- (a) $\frac{4}{7}$ (b) $\frac{1}{10}$ (c) $\frac{3}{10}$ (d) $\frac{4}{9}$
34. Two fair dices are tossed together once. What is the probability of getting a total of at most 7 from the outcomes?
- (a). $\frac{7}{12}$ (b). $\frac{1}{4}$ (c). $\frac{7}{36}$ (d). $\frac{1}{6}$
35. A coin is tossed. What is the probability of getting a head?
- (a) 1 (b) 2 (c) 3 (d) $\frac{1}{2}$
36. Add $3x^2 - 7x + 8$ to $7x^2 + 4x - 5$
- (a). $10x^2 + 3x + 3$ (b). $8x^2 - 3x + 3$ (c). $7x^2 + 3x - 3$ (d). $10x^2 - 3x + 3$

37. Find the remainder when $4x^3 - 5x + 4$ is divided by $2x - 1$
- (a). -2 (b). 3 (c). 4 (d). -2
38. What is the remainder when $F(x) = 2x^3 - 2x^2 + x - 1$ is divided by $x - 1$?
- (a). 1 (b) 2 (c) 0 (d) -2
39. Simplify $\frac{3x-2}{5} + \frac{x+1}{3}$
- (a) $\frac{14x-1}{13}$ (b) $\frac{16x-1}{15}$ (c) $\frac{14x+1}{15}$ (d) $\frac{14x-2}{15}$
40. Divide $x^3 + 64$ by $x - 3$
- (a). $x^2 + 2x + 9$ R.91 (b). $x^2 + 3x + 9$ R. 91
(c). $x^2 + 3x - 9$ R.91 (d). $x^2 - 2x + 9$ R.91
41. Given $\frac{8}{9}, -\frac{4}{3}, 2, \dots$ find the 5th term
- (a). $\frac{9}{2}$ (b). $\frac{4}{5}$ (c). $\frac{7}{8}$ (d). $3\frac{8}{9}$
42. The 6th term of an A. P. is 35 and the 13th term is 77, find the first term.
- (a) 5 (b) 4 (c) 6 (d) -5
43. What is the 12th term of the G.P. 2, 14, 98, . . .
- (a) $2(6^{10})$ (b) $3(6^{11})$ (c) $2(7^{11})$ (d) $4(7^{11})$.
44. Find the range of values of x for which $5x - 4 > 11$
- (a) $x < 3$ (b) $x > 3$ (c). $x > 5$ (d). $x < 1$
45. Find the gradient of the following points (2,5) and (4,9).
- (a). 3 (b). 4 (c). 2 (d). -2
46. What is the gradient of the equation $3 - x + 2x = 9$
- (a) 2. (b). -2 (c). -3 (d). 1
47. Given that x is an integer, find the value of x that are possible in the equation $7x + 13 < 2x$
- (a) $x < 2\frac{3}{5}$ (b) $x > -2\frac{3}{5}$ (c). $x < -2\frac{4}{5}$ (d). $x < -1\frac{2}{5}$

48. What is the probability of getting a 7 when a die is rolled once?

- (a) 2 (b) 3 (c) 0 (d) None.

49. Find the midpoint of the points (2,5) and (4,9).

- (a) 3, 7 (b) -3, 4 (c) 3, -7 (d) 2,4

50. Given an arithmetic sequence 5,9,13,...find the 10th term of the A.P.

- (a) 42 (b) 43 (c). 41 (d) 50.

ANSWERS TO THE ART

1C	11A	21A	31A	41D
2C	12C	22D	32A	42C
3B	13D	23B	33D	43C
4B	14A	24B	34A	44B
5A	15B	25C	35D	45C
6A	16A	26C	36D	46D
7D	17C	27A	37D	47C
8B	18B	28A	38C	48C
9D	19C	29C	39A	49A
10A	20C	30C	40B	50D