EFFECTS OF INTERACTIVE E-NOTE AND PROBLEM-SOLVING STRATEGIES ON STUDENTS' LEARNING OUTCOMES IN JUNIOR SECONDARY SCHOOL MATHEMATICS IN KADUNA, NIGERIA

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A Thesis in the Department of Science and Technology Education,
Submitted to the Faculty of Education
in partial fulfillment of the requirements for the Degree of
DOCTOR OF PHILOSOPHY
of the
UNIVERSITY OF IBADAN

SEPTEMBER, 2019

ABSTRACT

Mathematics serves as the bedrock for the development of science and technology, but many secondary school students perform poorly in the subject in public examinations especially in Kaduna State, Nigeria. This has been attributed to the use of ineffective instructional strategies by teachers and has become worrisome. This necessitated experts advocating the need to complement mathematics teaching with tools that could engage learners in active learning. Previous studies concentrated largely on computer assisted instructions, concept mapping and cooperative instructional strategies to improve students' achievements to the neglect of Interactive e-note Mathematics Instructional Strategy (IMIS) and Problem-Solving Strategy (PSS) which might be capable of enhancing students' achievement in and attitude to mathematics in junior secondary schools students. This study therefore was designed to determine the effects of IMIS and PSS on junior secondary school students' achievement in and attitude to mathematics in Kaduna, Nigeria. The moderating effects of gender and school type were also examined.

Gagne's Behaviorist and Bruner's Discovery Learning theories provided the framework, while the pretest-posttest control group quasi-experimental design using 3x2x2 factorial matrix was adopted. Two Local Government Areas (LGAs) were randomly selected within Kaduna city. Three each of private and public schools were purposively selected from the two LGAs based on availability of functional computers and standby electricity generators. Schools were randomly assigned to IMIS (134), PSS (134) and control (132) groups. Treatment lasted 12 weeks. Instruments used were Mathematics Achievement Test (r = 0.87), Students Attitude to Mathematics Questionnaire (r = 0.79) and instructional guides. Data were analysed using Analysis of covariance and Bonferroni post-hoc test at 0.05 level of significance.

Participants' age was 12.60 ± 2.30 years and 59.0% were female. Treatment had a significant main effect on students achievement in mathematics ($F_{(2,385)}$=7.01; partial η^2=0.04). The participants in IMIS had the highest post achievement mean score (21.48), followed by control (20.42) and PSS (20.30) groups. There was a significant main effect of treatment on students' attitude to mathematics ($F_{(2,385)}$ =65.45; partial η^2=0.25). The participants in IMIS had the highest attitude mean score (105.39), followed by PSS (100.35) and the control (97.51) groups. School type had significant main effects on students achievement ($F_{(1,385)}$ =27.63; partial η^2=0.07) in and attitude to mathematics ($F_{(1,385)}$=15.73; partial η^2=0.04) in favour of students from private schools. Gender had no significant main effects on students' achievement in and attitude to mathematics. Treatment and school type had a significant interaction effect on mathematics achievement ($F_{(2,385)}$=12.23; partial η^2=0.06) in favour of students' from private school in control group. Treatment and school type had significant interaction effect on attitude to mathematics ($F_{(2,385)}$=5.9; partial η^2=0.03) in favour of students' from private school in IMIS group. There was no significant three-way interaction effects on achievement in and attitude to mathematics

Interactive e-note and problem-solving instructional strategies enhanced students' achievement in and attitude to mathematics in Kaduna, Nigeria. Therefore, the two strategies should be adopted as modes of instruction, particularly in public secondary junior schools.
Keywords: Interactive e-note strategy, Problem-solving strategy, Students' achievement in mathematics, Students' attitude to mathematics

Word count: 488

ACKNOWLEDGEMENTS

My sincere appreciation goes to my employer; Forestry Research Institute of Nigeria (FRIN) for granting me permission and approval to undergo this course.

I also appreciate the support of my indefatigable supervisor Prof. Akinsola M.K without whom this research work would not have been possible. Furthermore I sincerely appreciate my head of department, Prof. Ige T, Prof. Adesoji F, Prof. Olagunju A.M, Prof. Aremu A,Dr Tella A,Dr Ukoh E.E, Dr Israel O, Dr Abimbade D, Dr Akinyemi A, Dr Omilani N in the department of Science and Technology Education and Dr Akinola S.O from computer science department for their immense contribution towards the successful completion of this work.

Similarly I appreciate the efforts of all my colleagues in the department for their cooperation and understanding. I also acknowledge my in-laws Mr and Mrs Dare J who accommodated and cared for me throughout the duration of this course.

Above all my heartfelt appreciation goes to my darling wife Mrs Olumuyiwa B. and our children Joan and Joel for their understanding, prayers, moral and financial support while undertaking this laudable program. May God's mercy and favour never depart from you all in Jesus name (Amen)

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CERTIFICATION

I certify that this work was carried out by Mr. A.S. Olumuyiwa in the Department of Science and Technology Education, University of Ibadan, Ibadan

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DEDICATION

This research work is dedicated to the glory of God Almighty the creator of heaven and earth, the giver of life and author of divine wisdom. He alone has been my provider, protector, support and helper throughout the duration of this program. Hence all glory, honor and majesty are ascribed to Him.

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LIST OF ABBREVIATIONS

WASSCE	West African Senior School Certificate Examination
WAEC	West African Examinations Council
ICT	Information Communication Technology
ANOVA	Analysis of Variance
NCCE	National Commission for Colleges of Education
BECE	Basic Education Certificate Examination
NECO	National Examinations Council
CAI	Computer Aided Instruction

CHAPTER ONE

INTRODUCTION

1.1 Background to the study

Mathematics is pivotal to the success of any venture in life, be it engineering, medicine, teaching and even in the business world, and therefore, Mathematics can be referred to as a fundamental science necessary for the understanding of other fields. It occupies a central position in the school curriculum as one of the core subjects at the junior and senior secondary school levels of education in Nigeria. Mathematics has an enormous impact on science and the society at large; the influence may be silent and appear hidden, but has shaped our world in many ways (Gauss, 2010). Mathematical ideas have made possible the revolution of electronics, which has transformed the way we think and live today (Gauss, 2010). A lot of changes have come up in the field of sciences and technology as a result of mathematics advancement (Jegede, 2011, Delving, 2009; Olusi and Anuolu, 2010; Jain, 2010, Amao and Disu, 2012). If Nigeria economy will grow and develop according to nation expectation there is a need for mathematical knowledge and idea that can enable science and technology to come into limelight to bring desirable economy changes in the nation (Kolawole, 2007). For any nation to experience sustainable nation building, there are roles to be played by mathematics education. As far back as when formal education started in Nigeria, Mathematics education has experienced different changes or revolution from different time to the other such as from Arithmetic, Algebra to Geometry and so forth.

Recognition of importance of mathematics to development of nation in the area of science and technology in the society has led to the various trends that mathematics has been going through till recent time. Mathematics has been recognized as basic analytical tools for different theories postulation in different fields, especially science related fields (Amao, 2015). Mathematics is very useful in scientific research because of its value in describing experiments and observations. Mathematics is very useful in almost science-related field to interpret model, concepts and theories. Nobody can really advance in sciences and other related fields without Mathematics (Eze, 2007; Jain, 2010).

Mathematics is an indispensable tool for proper understanding of society and the world around. Mathematics laid foundation for science of structure, along with order, and relation because all these moves around mathematical concepts such as mode of counting, measurement and as well as description of objects in different shapes. Mathematics involves quantitative analysis and calculation as well as logical reasoning (Grouba, 2008). The importance of Mathematics is noted by individual in the aspects of making valuable decision and also in various business and finance decisions. It provides tools for better knowledge of economics, science and technology of any nation. Mathematical ideas can be very useful in taking rational decision in public matter as well as involvement in nation economy through knowledge of its status (The Strategies, 2007). The basic tools that can help the students to critically analyse, explain and bring changes to the world in which they live can be acquired through the knowledge of mathematics (Beans, 2008). Foundational knowledge of Mathematics is very essential in securing admission to desirable career and getting desirable job. It is very important in the modern time advancement in technology. Students can limit their career choices if they fail to learn mathematics earlier enough at their high school (Meece, Wigfield and Eccles, 2010). Mathematics helps individuals understanding the world in which they live (Rene Descartes, 1596- 1650; Nokoe, 2008). Descartes affirmed that science depends on Mathematics. Nokoe (2008) did not accept the assumption of George Berkeley (1685- 1753) and David Hume (1711-1776) that Mathematics is merely ordinary ideas without any meaningful things to be deducted from it. Nokoe (2008) reacted that mathematics gives direction to sciences. The reason for misrepresentation of mathematics is its formulas that requires individual to cram for accurate computation and despite this misconception of Mathematics, it is still the cornerstones of any advancement in science and technology of any nation (Nokoe, 2008). Mathematics has been seen as mode of communication that is rightly useful to different scientific researchers (Uzo, 2002). Mathematics is considered to be body of knowledge that allows different field of studies to arrive at solution to any identified problem through rightful perception and formulation of certain ways to solve a particular problem specified (Odili, 2012). Alechenu (2012) affirmed that mathematics is the root at which other science related subject could be appropriately understood and without knowledge of mathematics those science-related subjected can be difficult to learn. (Alechenu, 2012) stated that mathematics is behind any advancement in science and technology of any nation, therefore, government should embrace the teaching and learning of mathematics and should not underestimate the role of mathematics education in this modern time of rapid development of technology.

Although mathematics is very important to scientific and technological development of any nation, but some students still fear Mathematics (Amao, 2015). Students' achievement in Mathematics has not been encouraging and it has become a perpetual educational problem in Nigeria. The core nature of Mathematics in schools has made the poor students' achievement in Mathematics a major concern to researchers in the field of Mathematics education (Sanni and Ochepa, 2002; Uloko and Imoko, 2007; Abakpa and Agbo – Egwu, 2008). In 2006 the failure rate in Mathematics was not encouraging because Nigerian students overall performance in Mathematics was so low to the extent that Nigeria as a nation held 10th position out of eleven nations involved in School Certificate Examinations (Abakpa and Agbo-Egwu, 2008). Many students in tertiary institutions in Nigeria today are not studying the courses of their choice because of not making the required grades in ordinary level Mathematics in the same School Certificate Examination. Most students regard making Mathematics compulsory at primary and secondary school levels as a punishment (Obodo, 2004). Students' performance in classroom as well as external examinations in Mathematics has not been encouraging because students persistently display poor knowledge of mathematical skills and concepts (Abakpa and Agbo-Egwu, 2008). WAEC (2014) also affirms the students' poor performance in Mathematics through its statistical reports over a period of time. Table 1.1 further attest to student's poor performance in Mathematics from 2005–2017 in Nigeria. This trend was also noticed in Basic Education Certificate Examination, which is also known as BECE, Mathematics result from 2011 – 2016 as analysed in Table 1.2.

Table1.1: Analysis of WASSCE Mathematics Results of May/June 2005 -2017 in Nigeria.

NUMBER AND PERCENTAGE OBTAINING GRADE							
YEAR	**Total Enrolled for Exam**	**A1-C6 Higher Passes**	**% Higher Passes**	**D7-E8 Poor Passes**	**% Poor Passes**	**F9 Outright Failure**	**% Outright Failure**
2005	1,054,853	402,982	38.20	276,000	25.36	363,055	34.41
2006	1,181,515	482,123	40.81	366,801	31.04	332591	28.15
2007	1,249,028	583,921	46.75	333,740	26.72	302,764	24.24
2008	1,292,890	726,398	52.27	302,266	23.83	218,618	17.23
2009	1,373,009	634,382	47.04	344,635	25.56	315,738	23.41
2010	1,306,535	548,065	41.95	363,920	26.85	355,382	27.20
2011	1,508,965	608,866	40.40	474,664	31.50	421,412	27.90
2012	1,550,224	723,024	46.64	445,224	28.72	380,425	24.54
2013	1,399,178	618,996	44.24	371,202	26.53	406,181	29.03
2014	1,547,178	621,950	40.20	427,342	30.53	451,301	29.17
2015	1,593,442	544,638	34.18	598,401	37.55	450,403	28.27
2016	1,544,234	597,310	38.68	446,302	28.90	500,622	32.42
2017	1,559,162	923,486	59.22	434.200	27.86	201,476	12.92

Source: The West African Examinations Council 2005 – 2017 WASSCE Mathematics Result

Table 1.1 gives the reports on students' performance at the senior secondary certificate examination from 2005 to 2017 in Mathematics. The table reveals that students performance with grades A1 – C6 recorded the highest percentage (59.22%) in 2017 followed by (52.3%) in 2008. There was noticeable improvement in students' performance from the year 2005 to 2008. Year 2009 to 2011 recorded decline in the performance of students' with grades A1 –C6 from 47.0% to 40.4%.There had been a consistent poor performance since 2012 until 2017 where we have marked improvement. The West African Examination Council (WAEC) Chief Examiners report (2012) suggested that, for a student to come out with good performance in Mathematics, they should study the syllabus in order to know the scope of coverage, be encouraged to study effectively and be exposed to mathematical facts, concepts and principles as well as how to apply them accurately in answering questions and also be well exposed to past WASSCE questions.

Table 1.2: Analysis of BECE Mathematics Result, 2011 – 2016

YEAR	TOTAL CANDIDATES	A (%)	B (%)	C (%)	D (%)	E (%)	F (%)	NG (%)
2011	56,025	9,244 (16.5)	19,217 (34.3)	16,135 (28.8)	8,908 (15.9)	1,961 (3.5)	504 (0.9)	56 (0.1)
2012	58,069	9,001 (15.5)	19,260 (33.2)	17,576 (30.3)	9,794 (16.9)	1,916 (3.3)	465 (0.8)	58 (0.1)
2013	59,088	6,795 (11.5)	20,445 (34.6)	19,972 (33.8)	9,690 (16.4)	1,773 (.3.0)	355 (0.6)	59 (0.1)
2014	59,620	5,545 (9.3)	19,078 (31.8)	20,688 (34.7)	11,864 (19.9)	1,968 (3.3)	358 (0.6)	59 (0.1)
2015	58,874	6,535 (11.1)	18,722 (31.8)	19,016 (32.3)	11,775 (20.4)	2,218 (3.8)	353 (0.6)	58 (0.1)
2016	59,412	9,324 (15.7)	19,126 (32.2)	20,327 (34.2)	8,620 (14.5)	1,477 (2.5)	480 (0.8)	58 (0.1)

Source: National Examinations Council (NECO), 2011 - 2016

From table 1.2 the highest percentage scores of students in basic education certificate examination (BECE) Mathematics within the six year period was 34.3% in 2011,33.2% in 2012 ,34.6% in 2013,34.7% in 20114 , 32.3% in 2015 and 34.2% in 2016. The first three years, 2011, 2012 and 2013 resulted in students obtaining a B grade while the last three years show that many of the students obtained a C grade. A careful study of this result shows that more than 50% of the students obtained between grades A to C but there is still the need for improvement on the teaching strategy being employed at this level of education in Nigeria to further enhanced students better performance in Mathematics.

One major factor in the achievement of students is the teacher. In fact, teachers are central to the performance of students. The National Policy on Education (NPE) asserted that no educational system can rise above the quality of its teachers (FRN, 2004). The quality in this context refers to teacher attitudes, teaching experience of the teacher and their versatility on methodology. Teacher's attitude is a great determinant of students' disposition to learning of Mathematics. Yara (2008) affirmed that students' academic performance and their disposition to learning of mathematics are determined by their teacher attitude towards Mathematics. Ofoegbu

(2004) identified poor disposition to work and inappropriate teaching habits of teachers as part of factors affecting students' performance in mathematics.

Popoola (2002) and Akinsola (1994) stated that students usually display poor disposition to learning of mathematics which invariably reduces students' interest in Mathematics and later students' poor performance in the subject. These are linked to students' attitudinal disposition to mathematics. Attitude is defined as an inclination of students to be in a state of readiness to learn or act (Gagne, 1965). If there is certainty that the action will bring about success or previous experience have shown success as a result of certain action undertook in the past, then, there will be positive attitude to act now to do certain thing. The way individual think, behave and act are the main concerned of concept of attitude. Attitude has implication on immediate social group students relate with in their various environment, teacher, students as well as entire school environment. Studies have shown that students do not have positive attitude to learning of Mathematics and science in Nigeria (Fasasi, 2012; Igboegwu, Egolum and Nnoli, 2011). Study has correlated attitude to students' academic performance in Mathematics (Okebukola, 2013). Yara (2008), study revealed that teacher disposition (attitude) and mode of instructional delivery could have influence on improving students' attitude. Bolaji (2005) findings, revealed that teacher personality and methods of lesson delivery have great influence on students' positive attitude to learn Mathematics. The findings of this study revealed that if the students fail to play their part in putting up their effort and interest in Mathematics, it will be very hard for them to perform well in Mathematics (Yara, 2008). The study therefore recommended that the teacher should develop real rapport with the students by way of active students' participation in teaching and learning process. Again, teacher should involve students more in the meaningful learning of Mathematics by giving them chance to fully engage in learning activities in order to achieve desirable result in Mathematics.

There are several teaching strategies recommended by different researchers which are not limited to problem-solving strategy (Popoola, 2002), cooperative teaching strategy (Akinsola and Ifamuyiwa, 2008), mastery learning strategy (Abakpa and Iji, 2011), personalization approach (Akinsola and Awofala, 2009) and concept mapping (Awofala, 2011) among many others. Those recommended strategies are to improve students' academic performance and attitudes to Mathematics as well as general assessment in Mathematics. This present study focused on how to improve the teaching of Mathematics in junior secondary schools using interactive e-note and problem solving strategies.

The conventional strategy barely focused on how computer can be used by the students to bring about positive improvement in learning and the society they live through the knowledge of mathematics (Mukhopadhuyay and Greer, 2007). Application of computer has been basically on how it can improve teaching and less emphasis has been given to the learning or how students learn. Many teachers do not involve students in what they learn because they think that they have nothing to contribute, therefore, there is need for suitable pedagogical approaches to effectively deliver mathematics lesson to the learners. This bring about therefore the reason to research into other new and innovative teaching strategy such as interactive e-note Mathematics Instruction to bring about improved performance in the learning of Mathematics. If the teacher teaches Mathematics with appropriate innovative teaching strategies, students on their own will identify varieties of ways in which mathematics is very useful to them personally and within the classroom environment (Gonzales, Andrade, Civil, and Moll, 2001; Gutstein and Peterson, 2005). The students will be able to understand the implications and benefits of world decision making and even in their immediate society through the inclusion of mathematical ideas in the area of economy and political decision (Orey and Rosa, 2006; Mukhopadhuyay and Greer, 2007).

Some of identified factors that have contributed to students performance in Mathematics by scholars are teacher related factors such as shortage of qualified Mathematics teachers, poor teacher preparation, poor subject mastery, inappropriate method of teaching and teachers' poor disposition towards Mathematics (Adetunji, 2000; Adegoke, 2003). Others are students' related factors, such as poor background, anxiety, attitudinal problems, lack of interest in Mathematics, self-concept, poor study habits, poor assessment of memory ability, motivation, disadvantaged background, wrong techniques of solving problems, intellectual ability, failure to adhere to examination instructions, gender factor and insufficient preparation for Mathematics examinations (Ifamuyiwa, 1998; Esan, 1999; Olumuyiwa, 2012). There are also problems associated with techniques of teaching Mathematics (Akinsola, 1994, Oteyemi, 2001; Odogwu, 2002; Ojo, 2009 and Onobanjo, 2010). Also included are school and society – related factors, such as inadequate instructional materials, and inadequate relevant Mathematics textbooks. Lastly, there are government factors (Akinsola, 1999; Oyedeji, 2000).

Certain factors should be considered before choosing any teaching strategy, Oyeniran (2003). Oluokun and Oyeniran (2006) discussed some of the criteria for choice of teaching methods. The criteria discussed were categorized according to their similarities under four factors. These are learner factors which include age, maturity, intellectual capability, learners' need, attitude and interest; teacher's factors such as qualification, experience, specialization, versatility on methods and attitude; School and subject -matter factors includes nature of the subject, topic and behavioral objective and Environmental factors which include class size, instructional materials, infrastructure and societal perception. On the quality of teachers based on their experience, Hanushek, Kain and Rivin (2002) asserted that this is crucial schooling factor that explains difference in quality among schools.

There are some practices that lead to loss and anxiety in Mathematics in traditional conventional classroom settings. Those practices that usually lead to loss and anxiety in Mathematics are time deadline, imposed authority by teachers and public exposure (Curtain-Philips, 2011). As a result of this, there is a need to critically re-examine teaching strategies in classroom settings. Those teaching strategies that need more emphasis in Mathematics classroom settings are students' cooperation, problem solving and e-note Mathematics instruction (Ogochukwu, 2010). The fact that some students have anxiety in the traditional Mathematics classroom settings, there is a need for the teachers to map out teaching strategies that will make learning of Mathematics easier for the students' and also lead to better performance. Responses from students in Mathematics class that are incorrect should be handled with care in order to encourage students in learning and participation in Mathematics class.

Dennis (2005) study revealed that problem solving skill is the cornerstone to learning of Mathematics. Mathematics problems are presented to students to develop in them the potential for problem solving. The end result of mathematical problem solving is to arrive at a problem solution and while some other goals are to bring about new problem, coming up with new alternative solutions and interpretation of solution to a given problem or generalisation of results. Based on the Curriculum and EvaluationStandards for School Mathematics published by the National Council of Teachers of Mathematics, (1989) which was reviewed in (2007), advocates that a major goal for students' learning Mathematics are to become problem solvers with the aid of mathematical knowledge. Stanic and Kilpatrick (1988) recognized that Mathematics word problem concept has been in the curriculum as far back as 1650 B.C. Chris (2005) affirms that problem solving is like given a scenario that requires resolution usually in academic areas. Chris (2005) explained the requirement of becoming a problem solver, which he further stressed that a problem solver must have a potential ability to bring about ways to solve a particularly problem totally. Chris (2005) also stressed that problem solving in Mathematics revolves around being giving a certain mathematical problem in which students require to interpret the problem on their own, map out a way or method to get it solve, follow certain mathematical rules or procedures to arrive to the result and then critically analyze the outcome or result to examine if the answer they get is in line with the problem presented.

Literate people in Mathematics see Mathematics as the same as solving problems-doing word problems, interpreting figures, creating patterns, proving theorems, developing geometric constructions, and so forth. Meanwhile, people who are not interested in Mathematics, will see all Mathematical activities as problem solving. Dennis (2005), described problem as a given situation, or critical description of certain thing in which one has no idea that vividly satisfies that description. He further stressed that a problem solver is someone who perceives and accepts a particular goal without having an immediate ways to arrive to the stated goal. He further explained that for anyone to become a problem solver there should be a specify goal, an hindrance to the attainment of that goal for the individual, and the acceptance by an individual of that goal for its actualisation. Whatever classifies as a problem for one learner may not be a problem for another and this can be as a result that there is no any hindrance to the attainment of such goal or no acceptance of such goal. Schoenfeld (2008) also noted that definition of problem is relative because it depends upon an individual. The main reasons for different studies on problem-solving in Mathematics of secondary school students as far back as 1960 can be found in the works of Polya (2009), who specialized in cognitive psychology, specifically, cognitive science. Postulation of theories of human learning are major focus of cognitive scientists and cognitive psychologists (Frederiksen, 1984), meanwhile, Mathematics educators put their effort to understand how students relates and interact with Mathematics (Schoenfeld, 2008).

According to Ogochukwu (2010), learning Mathematics requires serious personal effort from students because Mathematics is a complex task that puts a lot of demands on students. Teacher needs to encourage students because they need to be motivated if they will do well in the subject. It will be of benefit to Mathematics educators to come up with mode of instructional strategies that will improve students' interest in Mathematics and also stimulate them as well.

Educators are making use of different types of educative software and multimedia that can be useful in the classroom presentation or activities in order to enhance teaching and learning (Tolhurst, 1995). The cognitive science has been particularly relying on computer simulations of problem solving (Adolphus and Aderonmu, 2012). When a computer programme can be designed to bring about series of behaviour that is similar or the same with the series for human being, then such computer programme is called a theory or model of the behaviour. Adolphus and Aderonmu (2012) and Ken (2013) come up with simulations of mathematical problem solving which improves students understanding of problem solving in Mathematics. The basic mathematical activity is problem solving because the main focus of Mathematics educators is performance of students in line with educational stated objectives and students' abilities of becoming problem solver independently. Balogun (1982) had noted that mathematical application illustration and interrelation among object skills could be easily displayed by the learners through problem solving skills acquire via analytic powers.

Polya (2009), suggested the procedures to engage students in problem-solving in Mathematics thus, introduce student to the problem, ability to collect important relationships about the problem given, identify and getting necessary requirement to arrive at the solution, critical examination of the basic requirement in relation to well proved solution and critical analysis. When students perception are acquired through hearing, seeing and doing are closely related to their critical thinking, then it is possible to lay good foundation for problem solving in Mathematics as it has been postulated by Jean Piaget theory (1896 -1980) of cognitive development.

Study has shown that when teachers make use of concrete instructional materials in teaching theoretical concepts in Mathematics the students' problem solving abilities improved (Adolphus and Aderonmu, 2012). The study also suggested the use of reflective thinking process after the students must have solved the problem. Based on this findings, effective teaching and good classroom environment can be possible considering students' learning styles, if students centered learning instructional presentation is adopted. True learning cannot take place if students do not mentally act upon information (by seeing, hearing, practicing), in such a way to understand and retain what he encounters. Problem solving concept in Mathematics has been regarded as a method of learning as well as outcome of learning (Akpan, 1987, Ubuz, 1984). Hence many terms like analytic, critical and reflective thinking, scientific method, discovery and inquiry have been used synonymously with problem solving (Akpan , 1987). For this reason, no two definitions of the concept have same connotation.

On interactive e-note Mathematics instructional strategy, Asiyai (2012), Gul and Yesilyurt (2011) affirmed that research evidences overwhelmingly support the claim that students learning improves when they interact with teaching materials and actively participate in their learning. There is need for Mathematics teachers to understand and promote teaching and learning activities that can facilitate and enhance learning in the classroom. Bayturan and kesan (2012); Gul and Yesilyurt (2011) further stressed that students have tendency to learn better if they were engaged in significantly appealing activities in Mathematics and Technology. The impact of Technology on aspect of education cannot be over-emphasised. The introduction of Information and Communication Technology (ICT) into teaching and learning, especially the products, has brought about an improvement in the content and the teaching methods. In general, ICT is in best position to bring about changes in pedagogical methods, increase access to quality education by individual and also bring changes to management in education system (Ikyumen and Nwafor,2013; Edith,2013)

To educators, great excitement always comes as a result of creative presentation. Battulga, Koushi, Tamura and Moriguchi (2012) study revealed the effectiveness of interactive 3DCG to improve undergraduate medical students' achievement and motivation, meanwhile Battulga etal (2012) in their study made use of e-class as support to instruction. Interactive e-note, which is imbedded in multimedia, involves combination of different digital media forms such as text, images, sound, and video, into an integrated multisensory interactive application or presentation to transmit information to an audience." It has strength to increase amount of information, couple with different types of information available to the learners. Students have tendency to build effective and accurate mental model far better than what they can do in text alone from the use of interactive e-note. Ogochukwu (2010) recent study revealed that students prefer attending classes where multimedia presentation is utilised because such classroom settings are usually interesting and exciting. Interactive e-note provides great opportunities and challenges for teaching and learning Mathematics. Therefore, it is very important for Mathematics educators to improve their teaching style by critically examine the opportunities and challenges inherent in new technologies. Interactive e-note has different communication channel, each of which has its advantages and disadvantages. Velleman and Moore (1996) study revealed what needed to make interactive e-note effective, that is, different communication channels must be balance; using each of the channel for a specific purpose it is meant for and that no channel should dominates others. Video as one of channels has potential strength to make students see outside the classroom settings. Video attracts individual concentration via editing, and can also control available time and space via time-lapse, slow motion, microscopic, or telescopic views.

Video presentation will be fascinating once the tools of communication channels are used effectively. Animation is also part of communication channel of interactive e-note. When the objects display on the screen can change and move in the real time, then it is called animation. Studies have shown that animation, that is motion on the screen, is very crucial to hold learner attention because it plays a major role in interactive e-note design. Narration is number three of interactive e-note components. It looks as if those engineers of interactive e-note do not know the values of oral presentation when it comes to narration. An oral narrative has potential strength to captivate learners' attention when it is used along with animation and concise outlines of key points. The last component of an interactive e-note is sound. Sound has potential strength to improve the interactive e-note setting. Sound can provide meaning to animated objects or it can balance mood presentation that has turned out to be over serious. In another vein, sound improves retention of mnemonic morphs.

Study on the school type by Regina (2010) revealed that school type has significant effect on learners learning outcomes in Mathematics. The findings showed that the smaller class has direct correlation to enhancement of teaching and learning of Mathematics. In addition, some studies on school type revealed the effect of school type on school practices, and as well as differences between effective and ineffective schools. Secondary schools typologically can be private or public based on ownership. The public secondary schools are owned and financed by Federal Government while privately owned are financed by private individuals. According to Alimi, Ehinola and Alabi (2012) secondary schools are required to function and operate in accordance to national objectives of education irrespective of the ownership. Base on this fact, the quality of students output from secondary schools is determined by their good performance at the final external examinations because this is yardstick to determine school system effectiveness. School system is assumed to be effective if the students' performance is good (Philias and Wanjobi 2011). Cynthia and Megan (2008) study also argued that there is a relationship between facilities availability in quality term and students' academic achievement in Mathematics and English. It is general opinion in Nigeria that private schools have sufficient human and physical facilities, therefore, private schools students perform better than public school students. As a result of this, many parents prefer registering their children in private schools.. The current educational policy in the United States schools focused on market forces (Craig, 2010). This implies that education is seeing as market place where deregulation and competition in the market place will make experimentation, diversity, innovation and performance occurs at less expenses. This act of deregulation and competition in education sector will result in making quality education available to individuals irrespective of their status and disabilities. Milton Friedman (1955) in (Craig, 2010), also affirmed the philosophy behind school vouchers. This perceptive implies that competition for students, teachers, facilities, and funds will improve students' performance in schools and this will make school to produce students who are ready to learn and increase their scores in mathematics achievement tests. The competition among schools will improve performance and it will make those good schools to flourish and make those schools without standard to fail or improve on their standard if they will continue to exist. This competition among schools will improve general level of education in Nigeria. In free market economy, consumers are giving freedom of choice and they can move from between option. This encourages competition in the market and it also makes private enterprise to be more effective than public enterprise. This philosophy also is the same as Nigerian national identity of democratic freedom and free enterprise. A free market gives consumers the freedom of choice and free and fair society provides the platform to do so.

According toCraig (2010) the perceptive of a private or public in a free market makes school to be seen as a black box. There is no measure to determine if school performance is improved and why students' performance improved or not improving. It fails to explain how to improve teachers' lesson delivery or how changes in curriculum, facilities, class size, governance and administration might improve student performance. Rather, free market framework represents "invisible hand" postulated by Adam Smith and such mechanisms of invisible hand determines the students and school improvement (Craig, 2010). To get this done, private schools get students across different geographical boundaries and also remove all barriers of geographical or residential segregation that are very common to traditional public schools in Nigeria.

Private schools reduce the need for desegregation measure because it gives parents and learners educational option that is very fascinating in which they will voluntarily draw to. Private schools provide instructional or curricular innovation or different educational opportunities that can draw students in. Besides, private schools provide a platform that is racially and economically diverse. Practically, private schools have some basic assumption that link learners interest with studies and also exposing learners to more diversity which may invariably improve students' academic achievement. This is quite different from the idea that pressures from competitive market will create improvement in both school and students' achievement. Although many research have been conducted to investigate if school type lead to students' academic performance (Bifulco and Ladd, 2006; Esposito and Cobb, 2008; Rouse and Barrows, 2008), the findings are controversial because some studies reported that school type competition leads to improvement and while some studies find none. Many of these studies conducted are observational and the few experimental studies conducted yielded inconsistent results. Based on different studies on the school type, it has been noted that the school type influences students' achievement.

Singh and Imam (2013) also looked into the effect of institutional and personal variables on students' academic performance. This study was carried out in India in which the researchers investigated the effect of school climate, school type and medium of instruction on students' achievement in Mathematics. The total population sample was 1944 students which comprised 969 female and 975 males. Thirty six (36) schools from South-East Bihar in Indian. The researchers designed achievement test, school climate and attitudinal questionnaires to collect data from the respondents. The data collected were analysed using appropriate statistical instruments. The study showed that between male and female, there was significant relationship in their achievement in Mathematics. This implies that the males have good disposition to school climate and Mathematics better than their female counterpart. The reports of the findings also showed that students from school owned by federal government and private owned performed better in Mathematics than those schools owned by state government and minority managed schools. Additionally, the findings from this study showed positive correlation between school climate and students' performance. Positive relationship also exists between students' disposition to Mathematics and students' achievement. Singh and Imam (2013) study examined school variables on how they interacted with other cognitive variables to predict achievement in

Mathematics and it revealed specifically the effects of school variables on achievement of students in Mathematics.

Meremikwu and Enukoha (2010) investigated on how mathematics achievement of students influence by school type, that is, private and public, and also where the schools are located, that is, urban or rural. The study was conducted in the River state of Nigeria. The research design was quasi-experimental and six hundred students were selected for this study through multi-stage sampling technique. The main variables for this study were school location and school type. There are two groups in this study. One group exposed to the lesson with aid of instructional materials. The findings of this study revealed that learners' achievement was not determined by gender but rather by whether school is private or public owned, treatment and school location. Interactions among the treatment, school type, school location and gender yielded statistical significant in describing learners' achievement. The findings revealed that learners in the urban areas from private schools performed better than learners from the public owned schools. Again, the mean scores differences between learners' from private and public owned schools in mathematics were not significant. Finally, this study revealed better understanding on how instructional materials, school location and school type could play a critical role in improving students' achievement in Mathematics

According to Craig (2010) some studies used local sample, which lead to limitation of external validity of such study. Quasi-experimental and observational studies are common research while experimental is rarely conducted. Many studies have focused on private schools while only few studies were conducted to compare school type and students' academic achievement. The main reasons for divers schools types include assumption that students' achievement is predicted by school type and that better school performance will result to better students' performance (Raudenbush, 2004, Lubienski and Lubienski, 2008, Regina, 2010, Craig, 2010). The reason for recent increase in demand for various school types and school choice is because of relationship that exists between students' achievement and school characteristics. The expected improvement can become a reality by assumption that market forces framework, relationship between curricular and students interest, diverse cultural environment, freedom of choice or various combination of all these can improve learning of Mathematics. Flaxman, Guerrero, and Gretchen (1997) findings revealed that there was no difference that was significant between large schools within city and comprehensive schools in achievement but there was a significant difference in the area of perceived parental support and parental attitude. Especially in this country, Nigeria, availability of teachers is strongly correlated with higher students' performance in Mathematics. According toMeremikwu et al (2010) private schools have more of mathematics teachers' than public schools in Nigeria. Unavailability of Mathematics teachers in public schools makes teaching of the subject more difficult.

Gender is another moderating variable in this study beside the school type. Many researchers have looked into how students' achievement was influenced by gender in which there were different reports as regard gender influence on students' academic achievement. In study conducted by Okeke (2001) there was a significant gender difference between achievement in Mathematics and other science related subjects. Research have shown that the average scores of students' achievement in Mathematics favours of male students (Bilesanmi-Awoderu 2002, Olaleye, 2004, Aremu 2005, Abiona 2008, Ojo 2009); occasionally in support of female students (Olatundun 2008) and many studies also showed that both achievement and attitudes of students were not influenced by gender differences in sciences and Mathematics (Raimi and Adeoye 2002, Owoyemi 2007, Oduwaye 2009, Okoye 2010). Many research showed that there was significant difference between female and male students in favour of female students (Bolorunduro, 2005). According to Aremu and John, 2005 the way forward to close the gap that exists between female and male achievement in mathematics is an ongoing research. Gender is an issue receiving the attention of different researchers in the world (UNESCO, 2004).

Therefore, to improve free and human development there is a need to close the gap between male and female achievement in mathematics. One of the concurrent global problems is issue of gender inequality in education (Bordo, 2001; UNESCO, 2004; Reid, 2003). In a study conducted by Abiam and Odok (2006) there was no relationship that was significant between gender and achievement in some mathematics concepts. The finding also revealed that there was not a strong difference in performance of male and female students in trigonometry and geometry. Some people believed that Mathematics is for the male students and this statement may also widen the gap between male and female students' achievement in Mathematics (Mutemeri and Mygweni, 2005). Campbell and Storo (1996) investigated differences that exist in mathematics achievement between gender and their study revealed that there are some folklore that have been generally assumed to be true. Such myth is that men are quantitatively inclined while women are qualitatively inclined. The meaning of this belief is that girls are not suitable to go into any Mathematics-related career such as physical sciences and engineering. Meanwhile Millennium Development Goals (MDGs) sets to put an end to gap that exists between male and female at Basic and Secondary Education by year 2015.

Gender inequality requires more attention. Students' achievement in Mathematics usually attributed to gender differences. Kyei, Apam and Nokoe, (2011) compared the level of attention the teacher gives to female students and male students in mathematics classroom. A study also affirmed that male will still continue dominating mathematics and science related field (Olaleye, 2004). The students' expectation for success and attitudes determine students' differences in achievement in Mathematics not in their gender abilities (Kyei, Apam and Nokoe, 2011). Evidently, society attitude brings about many problems but the most detrimental aspect of it is that female students do not recognize their own personal potential and this does not limit them only in the classroom but also limit them in the choice of their future career (Olaleye, 2004). Additionally, many associate male achievement in Mathematics with male gene. Again, parents and teachers do not have much expectations for the females in science and Mathematics in comparison to high expectation for the males. Again, based on this fact, gender stereotypes were recognized as one of social factors by some Mathematics orientation models. Gender stereotypes that many teachers belief in and the students also absorbed affect the future of the female students' achievement in Mathematics (Banaji, Greenwald and Nosek, 2002; Olaleye, 2004). Both female and male students have in-built potential ability to learn skills that are embedded in Mathematics and are born interested in variety of objects and ideas (Spelke, 2005; Spelke and Grace, 2007). Gender as a moderating variable therefore attracted further investigation in this study because of the conflicting nature of results as revealed in the above researches that focus on gender and Mathematics. This variable was used in this study to bring about consistent evidence on the influence of this factor of gender on achievement and attitude through the use of interactive e-note Mathematics instruction and problem solving strategy in learning mathematical concepts.

1.2 Statement of the Problem

Mathematics serves as the bedrock for the development of science and technology, but many students perform poorly in it on yearly basis in public examination. This trend has been attributed to usage of ineffective instructional strategies by the teachers. Therefore, scholars have suggested adoption of instructional strategies that are capable of making students interact with technology and be a good problem solver while learning Mathematics; develop ability to link their past experiences with new ideas. Some of the strategies proposed and used in teaching Mathematics include concept mapping, personalization approach, mastery learning and cooperative instructional strategy. Extant literature has documented the effectiveness of these strategies on students' achievement and attitude in several school subjects.The use of e-note has not been well- researched especially at the Junior Secondary School level. This study, therefore determined the impact of Interactive e-note instructional strategy and Problem-solving strategy on junior secondary school achievement in and attitude to Mathematics in Kaduna, Nigeria, while the moderating effect of school type and gender were also examined.

1.3 Hypotheses

The following null hypotheses were tested at 0.05 level of significance.

$H_0$1: There is no significant main effect of treatment on students'

(a) Achievement in Mathematics; and

(b) Attitude to Mathematics

$H_0$2: There is no significant main effect of school type on students'

. (a) Achievement in Mathematics; and

(b) Attitude to Mathematics

$H_0$3: There is no significant main effect of gender on students'

(a) Achievement in Mathematics; and

(b) Attitude to Mathematics

$H_0$4: There is no significant interaction effect of treatment and school type on students '

(a) Achievement in Mathematics; and

(b) Attitude to Mathematics

$H_0$5: There is no significant interaction effect of treatment and gender on students'

(a) Achievement in Mathematics; and

(b) Attitude to Mathematics

$H_0$6:There is no significant interaction effect of school type and gender on students'

(a) Achievement in Mathematics; and

(b) Attitude to Mathematics

$H_0$7: There is no significant interaction effect of treatment, school type and gender on students'

(a) Achievement in Mathematics; and

(b) Attitude to Mathematics

1.4 Scope of the Study

This study was restricted to junior secondary one (JS 1) students from three private and three public secondary schools selected purposively from Kaduna North and Kaduna South local Government areas in Kaduna State. The concepts taught are approximations, number bases, basic operations and algebraic process as contained in the junior secondary School Mathematics curriculum.

1.5 Significance of the Study

The purpose of education is to bring about increase in knowledge (cognitive development), attitudinal change and development of skills, which so far has not been achieved, especially as observed in student's performance in Mathematics over the years due to conventional method of teaching employed by the teachers. This study is therefore considered significant because it might bring about improvement in Mathematics instructional delivery using interactive e-note and problem solving strategies in junior secondary schools to enhance student's performance and also build a positive attitude towards Mathematics in them.

Furthermore the students would realise from the outcome of this research that interactive e-note are motivators in learning; thus it will help to stimulate their interest in Mathematics. In addition, curriculum planners would become aware of the potential and effectiveness of interactive e-note and problem solving strategy; and will be able to recommend these strategies to teachers who would implement the curricula if found positive. The information from the study would help curriculum planners and educators to plan workshops and seminars to train teachers on the adoption and the use of the strategies. The outcome of this study would also form empirical literature on student's achievement using interactive e-note and problem solving strategies on student's attitude to teaching and learning of Mathematics

1.6 Operational Definitions of Terms

Thefollowing terms used in this study are defined operationally as follows:

Learning Outcomes: These entail students" scores obtained from Mathematics Achievement Test (cognitive) and Students' Attitude towards Mathematics questionnaire (Affective).

Achievement in Mathematics: This is the pretest and posttest scores obtained by students' on the Mathematics Achievement Test (MAT)

Attitude to Mathematics: This is the student's disposition, feeling or position regarding Mathematics as a subject, its teaching and learning in junior Secondary schools adopting Fennema-sherman Mathematics attitudinal scale

Interactive e-note: Is auser friendly electronic Mathematics note designed and developed to stimulate students' interest in learning Mathematics.

Problem Solving Strategy: This involves devising a method to solve a given problem following mathematical procedures and checking if the solution obtained is acceptable and in line with the stated problem using Polya model.

Conventional Strategy: Instructional technique in which the teacher dominates the lesson and act as the only source of knowledge.

School Type: Are schools owned by private individuals or government

CHAPTER TWO

REVIEW OF RELATED LITERATURE

Related literature were reviewed under the following subheadings:

2.1 Theoretical Framework

2.1.1 Robert M. Gagne Behaviorist Theory

2.1.2 Bruner's Learning by Discovery Theory

2.2 Conceptual Review of Literature

2.2.1 Interactive e-note Mathematics Instructional Strategy (IMIS)

2.2.2 Problem Solving Strategy

2.2.3 Strategies for Developing Problem Solving Skills

2.2.4 The Interaction of Problem Solving Abilities and the Use of Computers in Secondary School Mathematics

2.2.5 Conventional Strategy

2.2.6 Achievement in Mathematics

2.2.7 Attitude to Mathematics

2.3 Empirical Review of Literature

2.3.1 Interactive e-note Mathematics Instructional Strategy and Students Achievement in Mathematics

2.3.2 Interactive e-note Mathematics Instructional Strategy and Students Attitude to Mathematics

2.3.3 Problem solving Strategy and Students Achievement in Mathematics

2.3.4 Problem solving strategy and Students Attitude to Mathematics

2.3.5 School type and Students Achievement in Mathematics

2.3.6 School type and Students Attitude to Mathematics

2.3.7 Gender and Students Achievement in Mathematics

2.3.8 Gender and Students Attitude to Mathematics

2.4 Appraisal of Literature

2.1 Theoretical Framework

This study was anchored on Behaviorist and Discovery learning theories.

2.1.1 Robert M. GagneBehaviorist Theory

Robert M. Gagne an American educational psychologist in 1965 proposed an explicit behaviorist psychological foundation for teaching the common school subjects. He made learning subject of his focus. He postulated that learning takes place through the interaction between the learner and environment. As a behaviorist, his model is a comprehensive stimulus-response theory of learning from which specific prescriptions for teaching and learning are quickly derived. Gagne argued that learning has taken place if the learners can do what they cannot do before. The action that takes place because of learning can be analysed into different sub-acts. Gagne argued that teaching required planning of a series of instructional sequences each of which leads to mastery of a single sub-act. These sub-acts are then combined to form more comprehensive acts. Through analysis of the learning acts, Gagne believes it is possible to select the skills and conceptual understanding necessary to master each sub-act. Gagne described and ranked learning into different number quantitatively as below:

(i) Stimulus-Response(S-R): That learning is characteristically observed in young children and adults who are learning new materials. In S-R learning the learner concentrates on linking object and events, names and objects with reaction and actions.

(ii) Multiple Discrimination Learning: That child should learn at the earliest opportunity to discriminate among such characteristics of objects and events as in taste, weight, texture, smell and pitch. He said learning depend on concrete props and rich full experience. Mothers who routinely stimulate their children to observe the sights and sound of their surrounding give them a priceless start in life.

(**iii) Concept Learning:** The ability to infer and create concepts is based on skills in separating and identifying the characteristics of objects and events. According to Gagne, concept is defined as a group of objects that share similar characteristics or properties. For example to reach a more advanced conception of water, children must draw on experiences with glasses of water, rainwater, pond water, hot water, cold water and water encountered in other places and with applications. Concepts can be arranged in hierarchical order extending from simple to the most advanced and comprehensive.

(iv) Principle Learning (Process Skills): Gagne distinguishes between scientific principles such as the repulsion- like magnetic poles and the power of acids to neutralize alkalis and another class of principles called process skills which includes observation of a particular object in question, making use of time/space relationship, making use of numbers, using measuring, classification of objects, communicating, predicting and inferring. The aforementioned skills are very crucial for basic 1-6 children. Again, there are five additional proposed skills that are for basic7-9 which include (a) Formulation of Hypothesis (b) Manipulation of Variables (c) Interpretation of a given Data (d) Operational Definition and (e) Experimentation. All these process skills are very crucial in the science and Mathematics and they appear to be equally valuable to many other aspects of learning (Abimbade, 2013).

2.1.1.1Relevance of Gagne's Theory of Learning to the Teaching and Leaning of Mathematics

Abimbade (2013) opines that Gagne described the importance of previous knowledge to bring about learning of Mathematics which means that it is very essential to learners to master fundamental concepts first before moving on to master complex concepts. He made use of principles of programmed learning and he also brought about learning set to Mathematics mode of instruction. He proposed that learning should be presented in hierarchical form and this led to the method he called 'guided discovery'. Guided discovery mode of instruction is very helpful in teaching and learning science and Mathematics. Finally, he proposed the following stages to the planning of courses, curricular and lessons of instruction and assessment:

(i) **Planning of courses, curricular or lesson**: At this stage the following should be recognized

(a) The needs and interest of the learner

(b) The readiness of the learner, when to teach the child; Mathematics should be taught in the morning (appropriate room temperature). If a child is tired or hungry he/she is not ready to learn. Teach from known to unknown and this is where the idea of prerequisite knowledge is important.

(ii) **Conduct of Instruction**: The specific (actual) instructional objectives should be made vivid to the learners. This will serve as motivation, and create a drive for learning that is satisfying. Also learners must be actively involved and adequate interaction with the learning environment should be encouraged. Active participation will help in adequate internalization of information based on the stated objective.

(iii) **Assessment of Instruction**: With appropriate performance objective the teacher will be able to carry out adequate assessment of the learner. There must be feedback to the learner as the result of assessment will motivate the child to progress in learning and readiness in learning new things and new concepts. The whole process of teaching and learning should be assessed so as to discover the need to change or modify the teaching strategy. Gagne's approach has been adapted in America Association for Advancement of Elementary Science Curriculum

2.1.2 Bruner's Learning by Discovery Theory

Bruner's learning by Discovery theory 1961 states that any subject can be taught effectively in an intellectually honest form to any child at any stage of his development. The implications of this theory are that mathematical concepts can be taught at any level of the formal school system provided the difficultly level of the material are matched with the stage of mental development of the learner. Discovery refers to all forms of methods of obtaining knowledge for oneself by the use of one's mental processes. Bruner believes that it is only through the exercise of problem solving that the student learns the heuristics of discovery. The more practice given, the more likely one is able to generalise what one has learned into a style of inquiry that serves for any kind of task. The researcher is of the opinion that the beginning of instruction with the manipulation of materials followed by a series of questions and counter examples makes this possible in Mathematics education.

2.2 Conceptual Review

2.2.1 Interactive e-note Mathematics Instruction Strategy (IMIS)

Several studies focused on the influence of the use of interactive e-note, which is the part of multimedia, on students' attitude and achievement. One of those studies was conducted by Cox, Preston and Cox (1999) which examined two educational cases influence on learners' achievement and change of attitude. The study investigated difference in efficiency of both conventional mode of instruction and multimedia instructional strategy as they were used by the teachers' vis-à-vis learners' achievement and attitude. The study was experimental in nature in which the researcher made use of eighty (80) students from ninth grade for the study. There were two categories of sample for this study, that is, control and experimental group.

The researcher made use of (programmed films, diagrams and tapes) self-designed achievement test. The findings of this study revealed that those students who were exposed to multimedia mode of instruction performed better. The statistical report revealed that there was significant average performance in favour of those students who were exposed to multimedia mode of instruction than the control group.

Another study was also conducted by Algerioy (1999) to investigate the influence of the use of multimedia on the achievement of first grade secondary school students in Mathematics in Riyad. The study adopted quasi-experimental research design with sixty-two students' sample. The researcher divided the sample into two groups. The first sample group was taught with multimedia instructional method while the second group was taught by using conventional mode of instruction. The findings with respect to students level of retention, understanding and application, revealed that there was no significant difference between the average performance of control group and experimental group. Sterling and Gray (1991) investigated effect of computer based stimulated programme on the learners' tendencies and their response to the statistics course. The research design for this study was quasi-experimental. There were two groups in this study in which sample size for experimental group was 40 and that of control group was 36. The students under experimental group studied through the use of the stimulation program while control group students studied through the use of conventional method. The result of the findings revealed that there was significant differences in the average achievement in favour of experimental group.

Da'lij (2008) conducted a study in Riyadh in which he investigated the impact of locally produced Mathematics software on female students' achievement in Mathematics. The sample of this study was drawn from intermediary female students. The study made use of seventy female students. The students were divided into two equal groups in which one group was experimental and the other group was control. Experimental group students engaged in studying through locally produced software and the other group studies through traditional method.

The findings of this study revealed that there was no significant difference between average achievement of control and experimental group at 0.05 level of significant. Salem (2000) conducted a study on the impact of using computer as an educational tools in teaching statistical concepts on the development of students' statistical skills among Senior Secondary school students. The researcher adopted quasi-experimental design in which the researcher divided the sample into two groups. The first group was experimental group and second group was control group. The researcher selected 30 students for each group, that is, both experimental and control. The students in experimental group were taught through computer while students in control group were taught through conventional method. The findings of this study revealed that there were significant differences in the students' average between control and experimental groups in favor of the experimental group.

Nasr (2005) carried out a study to investigate the effect of the use of multimedia technology on effective teaching of Geometry to bring about improvement in students achievement and innovative thinking skills. The study adopted experimental based design. There were two groups in this study. One group was experimental group and the other group was control group. The experimental group was taught unit of circle in geometry through multimedia technology while the other group was taught the same content through conventional teaching method. The researcher conducted pretest for both groups on achievement test and innovative thinking test. The researcher also made the two groups to attempt the same test after the experiment. The findings revealed that there were significant differences in the average scores of control and experimental groups in favour of experimental group at the level of achievement in geometry concept (Circle). This was so because of interactive multimedia technology mode of instruction adopted. The study also revealed that there were significant difference in the average scores of both control and experimental group in favour of experimental group because of interactive multimedia mode of instruction adopted. The interactive multimedia technology is very useful to improve students' achievement and develop innovative thinking skills. The study revealed the effectiveness of the used programme to develop students' innovative thinking skills to handle geometry concept. The study also revealed the percentage of efficiency of the interactive multimedia technology in the students' achievement (72%) and development of thinking skills (71%) in geometry.

Atawaim (2000) conducted a study to investigate the impact of computer usage in teaching on primary six pupils in the Arabic language curriculum. The researcher made use of computer as an educational tool to improve students' achievement in Arabic language in Riyadh. The study was based on experimental design. There were two groups. One group was experimental group and the second was control group. Total sample for this study was sixty students. The researcher divided the sample into two equal parts for each of the group. Experimental group studied by using computer while control group studied by using conventional method. The findings revealed significant differences in the average performance of the students in the both control and experimental group in favour of experimental group. It also revealed that there were significant differences in the level of students' achievement and application level of computer usage.

Transfer Mode

Abimbade (1997) opines that computers are not basically designed for schools teaching and learning. They are introduced into the school as real- world resources. Hence the computer has to be adapted to the educational settings. Computers have found its way into the schools' management and administrative purposes in form of computer managed instruction. That is they are used for time-tabling, record keeping, examination data-bank etc. Similarly, computer software application such as electronic worksheet, statistical analysis software package, symbolic manipulation system and so forth has been recognized as important educational tools.However the application of curriculum software for teaching and learning has not found wide scale diffusion in schools in Nigeria.The teacher needs to know the importance of interactive e-note technology and how it can be used to enhance learning, if they will be able to efficiently utilise this technology to stimulate learning. Teacher needs to restructure the mode of instructional delivery to accommodate interactive e-note technology to stimulate learning.

Abimbade (2013) argued that the technology can be transferred into ways, that is, the product is first imagined or conceived and after which it moves form the conceiver to the people that will make use of such technology. The process involve is directional once the result of the experiment and the output from the users will automatically affect the final version of the technology product and even the way the end users will make use of the product. To integrate interactive e-note for effective and productive learning it would involve: stages, actions and implementers.

Table 2.1: Technology Transfer Model

Stages	Actions	Implementers
Needs Assessment	Is computer needed and why in the curriculum concepts and ideas to implement interactive e-note	Computer vendors Computer Scientists Educational specialist Curriculum Developers
Planning/Task Analysis	Analyze the objective and mission on integrating interactive e-note to plan teachers training	Education policy makers and specialist
Test of Feasibility(pilot testing)	To experiment with the interactive e-note. To contribute to the definition of the context of use in the classroom	
Validation	Analyze the experiment and suggest modifications	(Educators) Educational specialists And Teacher Experimenters
Revision	To correct flaws and implement the interactive e-note use	Computer scientists and Vendors, Educational Specialists (Educators), Curriculum developers
Dissemination	To plan the introduction of interactive e-note large scale use. The packages (soft-wares) produced in the curriculum	Head of schools. Teachers/students or pupils

Source: Modified CAI Integration Model (Adopted from Technology Transfer Model of Bottino, Forcheri and Molifino, 1998 cited in Abimbade 2013).

The above table reveals diverse actions and actors involved in the integration model. Different duties are performed by education teachers and specialists (who are experimenters), Computer vendors/scientists in our education system. They help in the development and procurement of computer hardware and software. Educational specialists involve from designing of the product in order to educate the teachers who the implementers, on the importance or opportunities offers in education by interactive e-note to enhance learning. If interactive e-note will be introduced into the school settings, the following need to be taken into considerations pre-requisite for its use, suggest educational itineraries and the level of end users competences. Education specialists usually plan ahead as regard what kind of educational training they need to expose teachers to, expected level of difficulties teachers can face as a result of the introduction of interactive e-note technology so that they can plan training to address any issue arise from the use of interactive e-note technology in the classroom environment..

Teacher-experimenters act from inside the school world in order to test and refine hypotheses and proposals, suggest changes based on students/pupils' reactions, disseminate the newly acquired expertise among colleagues and scholastic authorities (Abimbade, 2013). In this context a fundamental aspect of transforming interactive e-note in schools is the kind of relationship that exists between educational specialists and teacher experimenters. The relationships can be direct and indirect. By the expression indirect relationship we mean that the educationist work together with scholastic authorities to organize and plan activities for teacher experimenters while direct relationship means that educationists organize programs for teachers only. Any of these relationships can be adopted for interactive e-note integration.

2.2.2 Problem Solving Strategy

The concept of problem solving has been defined as a method of learning as well as a legitimate outcome of learning (Akpan, 1987, Ubuz, 1994). Hence many terms like analytic, critical and reflective thinking, scientific method, discovery and inquiry have been used synonymously with problem solving (Akpan , 1987). For this reason, no two definitions of the concept have same connotation. Furthermore the complexities of the solution processes of divers' problems preclude a standard definition of mathematical problem solving. However the views by different psychologists are highlighted below:

Gagne (1966) views problem solving as a way of deriving high order rule from previously learned rules needed for the solution of a problem.Ausubel (1970) in Udosoro (2000) stressed that problem solving is like discovery learning that bridge the gap between what learners have already known and the solution to the problem.Polya (1973) declares that problem solving needs some level of creativity ability in analyzing, synthesizing and evaluating situations.Lester (1978) in Udosoro (2000) differentiates between the terms Problem and problem solving by defining them thus: A problem is a given situation that one is called upon as an individual or group to perform a particular task in which there is no guideline on how such task will be performed while Problem solving is a process by which one performs set of tasks to arrive at a particular solution to such task.Ubuz, (1994) defines problem solving as a complex task that engages a variety of cognitive components and skills, motivational/attitudinal components as well as psychological components. By this viewpoint the cognitive component include domain knowledge, structural knowledge, and metacognitive skills. The motivational/attitudinal component includes exerting effort, persisting on task and engaging intentionally. Furthermore the psychological component consists of articulating prior knowledge using personal strategies.

These definitions suggest that:

1. Problem solving involves mental processes.
2. Problem solving requires some specialized skills and abilities
3. Problem solving involves conscious and systematic application of relevant information and skills to overcome an event see by a person as problematic.

Mathematics problem solving in this study denotes the ability to text-edit a problem statement, identify missing information and then use mathematical knowledge to solve the problem. To build a strong Mathematics foundation, Mathematics educators believe that Mathematics teaching should be hinged on the development of problem solving abilities (Akpan, 1987, Abimbade, 1987, Oguniyi, 1983). This is further demonstrated by the volume of literature and studies conducted in the last few years (Ubuz, 1994). Akpan (1987) posits that verbal or word problems have long been an area of Mathematics that is of great concern to teachers and the cause of much student anxiety. Also Akpan (1987) opines that word problems are considered as difficult concept in Mathematics by students from all levels. The competencies need by individual to live productively in the society change as the society needs changes (NPE, 1981). Base on this fact, students require some level of competencies in some areas of Mathematics which include problem solving, mathematical reasoning, and communicating mathematical ideas in order to make use of these concepts of Mathematics in everyday real life situations. Akpan (1987) stressed further that students should be taught with the mode of instruction that will improve students' level of problem solving, application, and higher order thinking skills. The major focus of Mathematics instruction is problem solving but most people are not problem solvers (Udousoro, 2000). Problem solving needs level of creativity before one will be able to analyse, synthesis and evaluate real life situation (Ubuz, 1994).

Models of Problem solving includes:

(a) Selvaratmam/Frazer Problem solving Model:

Selvaratmam/Frazer (1982) in Udosoro (2000) proposed a five step procedure for solving numerical problems in science thus:

1. clarify and define the problem ;
2. select the key equation;
3. derive the equation for calculations;
4. collect the data, check the units and calculations, and
5. review, check and learn from the solution.

They believe that the difficulties of many students in problem solving are due to an improper method and technique. The duo stressed that students have difficulty in knowing how to start, where to start and how to proceed with the analysis and solution to a problem. They conclude that problem solving is made easier if the necessity for a logical and systematic approach is appreciated.

(b) Hayes Problem solving Model

Hayes (1980) in Udosoro (2000) listed six stages in problem solving thus:

1. Looking for the problem (recognizing the existence of a problem to solve)
2. representing or tag the problem (having the understanding of the gap to fill)
3. Design the means to solve the problem (Making appropriate selection of a method for bridging the gap)
4. implementing the designed plan
5. checking (evaluating) out the way out devised (how good is the result); and
6. summarizing (consolidating) your gains (what experience learnt from solving the problem)

(c) Mettes Problem Solving Model

Mettes (1980) in Udosoro (2000) states that heuristics increases the chances of finding the solution for a given problem in science. He then develop a program of action method (PAM) . This program list the actions and methods used in solving problems in a systematic way thus:

1. Analysis of the problem;

2. Formation of standard problem

a. planning the problem solving process

b. writing down possible useful relations and checking for validity in problem situation

c. conversion to standard problem

3. Execution of routine operation;

4. Checking the answer and interpretation of the result

(d) Polya Problem Solving Model

Polya (1965) developed a model with four stages in solving mathematical problems thus: (1).Understand the problem (2) Devise a plan (3) Carry out the plan (4) Look back

A close examination of these models of problem solving reveals general recommendation for the use of instruction simulations, heuristics, Socratic dialogues and algorithm to involve students in problem solving in Mathematics. They have not identified the specific objectives that must be achieved in the development of problem solving abilities. For example Polya four step model presented the heuristic for solving problems but does not clarify the specific activities that the learner must engage in when solving a mathematical problem. Campbell and Storo (1996) opine that problem solving has shifted from general heuristics to domain specific knowledge and processes. Gagne (1992) recognizes that problem solving procedures are very complex and he proposes a very shot brief template for applying the events of instruction following concept learning rules and outcome. Furthermore, these models do not present systematic approach to problem solving unlike text assisted which present the lessons in a coherent sequence to the learner. Problem solving is very crucial types of learning and thinking. Conventional ranking model of learning postulates that problem solving involves building of blocks of component of learning in terms of concepts, rules and principles that the learners can refer to when confronting with a difficult task (Udousoro, 2000). To guide the development of problem solving skills and facilitate meaningful assessment of the exercise in this study, Polya's heuristics model will be adopted and modified to fit into text assisted program of instruction.

Researcher's Proposed Problem Solving Model

After a careful examination of various models proposed by previous researchers, Polya's models for Mathematics problem solving will be adopted in this study but with some modification in line with the suggestions by Campbell and Storo (1996).

Polya's Modified Problem Solving Model

Polya's model previously stated will be modified to reflect specific knowledge and processes which learners needs to apply when solving any mathematical problem. The stages in this model are:

1. Understanding the problem

This stage requires two basic processes namely factual knowledge and problem comprehension. Factual knowledge entails ability to bring to mind previously learned information by the learner. In comprehension, it is possible to reproduce knowledge without understanding. To demonstrate comprehension of problem students should understand the significant of the symbols used and show an ability to make substitutions, recognize examples and text-edit a problem to recognize sufficient data, irrelevant data or missing data.

2. Devising a plan

This requires routine and information transfer (Plan development). Students should understand several distinct processes/principles underlying a particular procedure. Information transfer may be shown by ability to change information in diverse forms: verbal to numerical or vice versa; formulation of equations and relationships; use of appropriate diagrams; plan development.

3. Carrying out the plan

To implement the plan the skill needed is that of using the information given correctly to solve the problem. Computational skills are required at this stage.

4. Looking back

This stage entails evaluation of the whole problem solving exercise. The skill needed here is the ability to check on the solution process to ensure that the solution obtained is correct.

2.2.3 Strategies for Developing Problem Solving Skills

Problem comprehension and problem solution are the two division of problem solving in Mathematics (Udousoro, 2000). Problem comprehension is a process of transforming every sentence of the task or problem into meaningful internal representation and incorporates the information given into well-organized solution. The act of planning, monitoring of the process and the implementation of the solution refer to problem solution (Udousoro, 2000). Ubuz (1994) opined that the most crucial aspect of problem solving in Mathematics is problem comprehension. Learners usually experience difficulties in the comprehension of problem and teachers never bother to help the learners as regard the difficulties in comprehending the problem but rather, more time are giving to problem solution.

(a) Text editing and problem comprehension

Adequate problem comprehension comes with the editing of the text of the problem (Low and Over, 1992). Text editing of problem statement will naturally lead to correct problem presentation. Fact got from the text in line with the structure of the problem is put into an equation in which solution comes as a result of computation and calculation (Ubuz (1994). Therefore text editing which ensures problem comprehension is a skill that one should develop in secondary school Mathematics learners. Competence in text editing enables the problem solver to ensure and decide beforehand that the problem statement contains all important information needed to solve the problem or to reach problem solution. Ubuz (1994) stipulated that problems are often made more real to the learners by omitted some problem component or elements which learners are to find out themselves the missing information in order for them to arrive into problem solution. Ability to detect missing data in a problem statement will make the student not to spend time trying to solve it at all. Another way to display this skill in knowing that crucial fact about the problem may be missing and is for the student to try to suggest and indicate this information Ubuz (1994). If the student do not know that certain information could be likely missing, the problem may likely result in inappropriate problem representation which may lead to frustration on the part of the student.

Ability to identify these given and assumed values could depend on how systematic students' approaches are or how good their knowledge of content is. When students are unsystematic, they may not consider what information is available or not as a necessary step towards an efficient problem solving exercise. Though this could indicate a poor knowledge of subject matter, it must be recognized that students can be made aware of such requirements in problem solving through the repeated use of a model which will likely improve their performance. Furthermore, problems are also made real by including irrelevant information in the problem statement that students do not need to solve the problem. Low and Over (1992) opines that the ability of students to separate relevant from irrelevant information is a crucial aspect of problem solving skills that should be developed and put into practice in Mathematics. The duo also asserts that students lacking this important skill quickly try to find the givens before calculating how these could be relating to the way in which to arrive to problem solution.

Frustration arising from inability to solve Mathematics word problems has been identified as major causes of Mathematics anxiety and math-phobia (Low and Over , 1992) and reduced Mathematics participation across the gender.

(b) Breaking of a problem into sub-problems

Having helped the learners to understand the problem and construct meaningful problem representation, a further skill necessary in a successful Mathematics problem solving is the learners' ability to break a particular problem into unit or sub-problems Ubuz (1994). Decomposing and simplifying of Mathematics word problem is a common teaching strategy that has often been recommended for solving mathematical problems. This strategy requires that students should divide the given problem into unit or small unit of problem and after which the learners can apply the decomposition process to the sub problems until problems are small enough to bring about clear solution.

(c) use of Diagrams in problem solving

The use of diagrams in Mathematics problem solving has been identified as another important skill which problem solvers must develop and apply from time to time (Nikandrov, 1990). Use of diagram in any instructional process enhances concretization of the lesson. Recalling that good teaching is always carried out in a concrete context (Toumasis, 1993), and the fact that quality teaching improves students ability to solve problems (Nikandrov, 1990). The importance of ability to use diagrams appropriately in Mathematics problem solving cannot be over emphasized. For instance (Nikandrov, 1990) in a study titled 'Fun with Logical reasoning, due to appropriate use of charts and diagrams the following were confirmed: improvement of analytical skill, identification of patterns and relationships, identification of faulty quantifiers, and as a means of proving their answers. (Nikandrov, 1990) posit that use of diagrams may reduce the number of steps required to reach a goal, thus making the solution easier and faster. Ubuz (1994) reported that charts and diagrams clarify concepts understanding and proper representation of variables.

(d) Writing of variation of a problem

The last strategy to be employed in this study to enhance mathematical problem solving skills is writing variations of a problem. (Toumasis, 1993) opines that a variation of a problem is a modification of the statement of the problem to obtain a new and related problem. By this strategy, variation of a given problem can be easily produced using the following principles:

(1) by changing the problem context or setting
(2) by varying the numbers,
(3) by reversing what is wanted and what is given
(4) by altering the conditions
(5) by adding extraneous information
(6) by combining changes of context or setting the numbers, the conditions or the wanted and given information.

Toumasis (1993) concludes that asking students to write their own problems can make students to have in-depth knowledge of mathematical ideas and improve their abilities to understand problems and interpret data.

2.2.4 The Interaction of Problem Solving Abilities and the Use of Computers in Secondary School Mathematics

` Study revealed that the rate at which people can use technology as significant influence on Mathematics problem solving ability (Dennis, 2005). This study pinpointed that the use of technology can serve as tools to Mathematics problem solving and not as a mode of instructional delivery or to receive feedback from students. Some of the studies on problem solving revolved around programming; many of those studies have been resulted to inclusive results. It is indeed that advent of computer program to solve mathematical problems or task can be helpful to improve programmers' understanding of Mathematics being used. Many at times the main focus of researchers is on programming skills but not on how to make use of programming to solve mathematical problems. In fact, Mathematics gives out a place where programming can occupy, and the focus of programming in Mathematics should be in Mathematics problems and how computer can be used as a tool to solve Mathematics problems. Technology can be designed to be of help to improve exploration of problem or conceptual situations. Take for instance, computer graphic calculator can assist students to have insight to different categories of curves such as the quadratic function $f(x) = ax^2+bx+c$ for divers values of a, b, and c. In the same vein, a computer graphic calculator effectively help students to work on integration of algebraic and graphical representations of equations and also increase students' understanding to make mathematical connections.

2.2.5 Conventional Strategy

A close examination of the current Mathematics classroom practices shows that the dominant strategy is lecturing which is teacher centered and tends to promote rote learning (Even, 1993). According to Ausubel's Meaningful Learning Theory, this method of teaching does not promote genuine mathematical understanding. In addition this strategy does not promote students active participation and independent work. With this practice also, students learn mechanically to solve problems, and where they cannot transfer their mechanical knowledge to new situations the result is lack of motivation and general poor performance (Ubuz, 1994)

2.2.6 Achievement in Mathematics

Students' poor performance in Mathematics in Nigeria has been a great issue and concern to teachers and researchers. Though Mathematics is very important subject in schools and also a pre-requites to admission into higher institution of learning but students failure in Mathematics has been a great concern to learning of Mathematics (Sanni and Ochepa, 2002; Uloko and Imoko, 2007; Abakpa and Agbo – Egwu, 2008). Nigeria recorded highest poor performance in Mathematics in 2006 and Nigeria was ranked 10th among eleven countries that involved in West African countries in School Certificate Examinations (Abakpa and Agbo-Egwu, 2008). Some students at higher institutions of learning could not offer the course of their choice because they could not pass Mathematics at the credit level in SSCE Mathematics which denied them of giving admission into course of their choice. Many students see making Mathematics as a core subject and compulsory to be passed at the credit level as way of punishing them that they do not have interest in Mathematics (Obodo, 2004). Performance of Nigeria students in Mathematics, especially at the external examinations, has not been encouraging. Students have been continually having low performance in mathematical concepts, theory, principles and generalization both in classroom and external examination (Bot, 2000).

2.2.7 Attitude to Mathematics

Studies have shown that students do show undesirable attitude to learning of Mathematics which usually as a result of their no interest attitude towards the subject, and this lack of interest always lead to poor performance of students in Mathematics at external examinations (Popoola, 2002; Akinsola, 1994). Gagne (1985) defined attitude as inclination of students to be in a state of readiness to learn or act. If there is certainty that the action will bring about success or previous experience have shown success as a result of certain action undertook in the past, then, there will be positive attitude to act now to do certain thing. The way individual think, behave and act are main concerned of concept of attitude. Attitude has implication on immediate social group students relate with in their various environment, teacher, students as well as entire school environment.

Studies have shown that students do not have positive attitude to learning of Mathematics and science in Nigeria (Fasasi, 2012; Igboegwu, Egolum and Nnoli, 2011). Study has correlated attitude to students' academic performance in Mathematics (Okebukola, 2013). Davis, Bagozzi and Warshaw (1989) affirmed that the Technology Acceptance Model (TAM) can be correlated with the rate or level one can make use of computer. They showed that individual attitude towards easiness in the use of computer and the usefulness of it affect the individual disposition (attitude) to the use of it and also showed that the training enhanced the self-efficacy in the use of computer by both gender (Igboegwu, Egolum and Nnoli, 2011). Respondents with positive disposition to computer can be assisted to improve their self-efficacy in the use of computer through training (Igboegwu, Egolum and Nnoli, 2011). Yara (2008) study revealed that teacher disposition (attitude) mode of instructional delivery could have influence on improving students' attitude. Bolaji (2005) findings revealed that teacher personality and methods of lesson delivery have great influence on students' positive attitude to learn Mathematics. The findings of this study revealed that if the students fail to play their part in putting up their effort and interest in Mathematics, it will be very hard for them to perform well in Mathematics (Yara, 2008). The study therefore recommended that the teacher should develop real rapport with the students by way of active students' participation in teaching and learning process. Again, teacher should involve students more in the meaningful learning of Mathematics by giving them chance to fully engage in learning activities in order to achieve desirable result in Mathematics.

2.3 Empirical Review of Literature

2.3.1 Interactive e-note Mathematics Instruction Strategy and Achievement in Mathematics

Several research findings have shown positive effects of multimedia instructiontowards academic achievement. Sara (2012) revealed that interactive multimedia bring about high level of retention for those students who were exposed to it than those who were taught by traditional methods of teaching. Sara (2012) also revealed that the multimedia program made students taught through it fared better in Mathematics than the learners taught through traditional method. Abu-Yunis (2005) in a study using multimedia found differences in academic achievement of students in the experiment and control groups in favour of the experiment group. Obaid (2001) and Abu-Nadar (2003) in their various studies discovered that the application of multimedia instruction enhanced students' academic achievement and enhanced their interests. Sara (2012) affirmed that the use of multimedia improved interaction between teachers and students. The economic and technological state of the nation Nigeria requires individuals who are armed with critical thinking skills and problem solving abilities which are embedded in the study of Mathematics. Therefore, the study recommended the need for the adoption of innovative teaching strategy for lesson delivery in Mathematics classroom environment.

2.3.2. Interactive e-note Mathematics Instruction Strategy and Attitude to Mathematics

Students require personal efforts to learn Mathematics because it is complex cognitive task that can put more pressure on the students if they will eventually learn Mathematics. As result of this, students need to be motivated to learn Mathematics (Ogochukwu, 2010). It is therefore very important for learning environment to make use of instructional learning strategies that will draw out students' interest in Mathematics. Educators have been making teaching and learning more interesting and exciting by making use of different forms of software and multimedia presentation in the classroom environment. Multimedia can be seen as the bringing together of many digital media types which include sound, text, images, video and power point presentation into an integrated multisensory interactive application to enhance lesson delivery to the learners. Interactive e-note is seen as user friendly and easy to use because of different useful feature imbedded in it. Interactive e-note can provide learners' with adequate useful information at the extended level. Ogochukwu (2010) affirmed that multimedia helps mental activities of the learners that can make students to be regular because it gives important avenue for teaching. A study revealed that multimedia presentation as mode of instructional delivery bring about high level of retention at 80% above every other mode of instructional delivery such as discussion methodsat 40%, conventional teaching methods with visual aids at 20% (Ogochukwu, 2010). It has been the role of Mathematics educators to consider the strength and weakness of media technology to know how to make use of it to enhance their mode of lesson delivery in Mathematics classroom.

2.3.3 Problem Solving Strategy and Achievement in Mathematics

Problem solving concepts achievement in Mathematics is very necessary if students will continue learning Mathematics. It is only some few studies in the field of Mathematics education that looked into area of educational media that can lead to adequate development of problem solving abilities of the learners which can be translated to positive attitude to Mathematics achievement. It is very important to improve Mathematics mode of instruction in Nigeria due to rapid development in secondary education in this country, Nigeria (Abe and Gbenro, 2014). Teachers need to get into new mode of instructional delivery willingly to bring about desirable improvement in learning of Mathematics (Abimbade, 1997). Based on the demand on the teachers in the area of time and energy spend it will be preferable to make use of students centered mode of instructional delivery strategies as a way forward to improve students achievement in Mathematics (Ubuz, 1994). There is serious worry that if students are allowed to make choice of their own devices for learning, they may find it difficult to succeed. Meanwhile study has shown that there would not be any problem once given adequate appropriate instructional materials and learners usually benefits from this and the personal skills acquire are also important reward (Ubuz, 1994). Polya (1966) suggested the procedures to engage students in problem-solving Mathematics as to introduce student to the problem, ability to collect important relationships about the problem given, identify and getting necessary requirement to arrive at the solution, critical examination of the basic requirement in relation to well proved solution and critical analysis. When students perception are acquired through hearing, seeing and doing are closely related to their critical thinking, then it is possible to lay good foundation for problem solving in Mathematics as it has been postulated by Jean Piaget theory of cognitive development.

2.3.4 Problem solving strategy and Attitude to Mathematics

Swarupa (2007) explains that Mathematics is human expression that connotes and reflects the contemplative reason, active will and the desire for aesthetic perfection. Its main construct component is laid on intuition analysis and logic, construction, individuality and generality. As a result of this, each Mathematics teacher should know and recognize that he or she is a talent scout and should always focus on the students. Abraham and Leigha (2007) study revealed that there is necessary efforts need to be put in place to bring about improvement in learners cognitive, affective and psychomotor skills. This effort must also include necessary skills require for problem solving in Mathematics. This would result to elimination of fear of Mathematics by the learners. Problem solving is considered as one of required and basic activities in Mathematics. The main concern of Mathematics educators is actualizing students' performance based on the different domains of educational objectives and also good performance of the students through their individual abilities as a problem solver. Balogun (1982), further stressed that mathematical application illustration and interrelation among object skills could be easily displayed by the learners through problem solving skills acquire via analytic powers.

2.3.5 School type and Achievement in Mathematics

Market theory motivates the relationship that exist between school governance system and academic outcomes (Davies and Quirke 2004; Smith 2003; Chubb and More 1990b; Walberg and Bast, 2003). This means that public schools that owned by government are hindered in effective delivery of educational service because of long time it takes to make decision and availability of public funds. Meanwhile innovative and efficient driven private schools have to compete among themselves and also respond to the needs of their consumers if they will survive. This situation of private schools is considered in charter school movement and voucher plans, which place private schools in a competitive position in which they must be innovative in order to improve and create opportunities for innovative and academic achievement. The school reform in the area of school reorganization, nonpublic service providers, parental choice and the threat of charter school status are to ensure that school effectiveness at all cost in America (Lubienski, Lubienski, and Crane,2008*)*. The market theory works towards given appropriate standard to schools in America. Every school knows that parents have a free choice to choose school they prefer. The competitive in schools to form effective learning process is as a result of preferences the parents have to choose their own desirable schools they want for their children. The main focus of market theory is external incentives along with issues relating to institutions and logic posits while it does not focus on internal structure of the school.

It should be noted that school organization itself does not teach children meanwhile the school may likely holds less the close or immediate interest of the children in the area of teachers' qualification, mode of instructional delivery type, or the class size and including main discussion on educational reform. Previous studies revealed the belief on the superiority of private schools over public schools and these studies that were conducted in 1980 involving High School and beyond data set. The studies revealed the effectiveness of private schools to improve students achievement than public schools when they considered socioeconomic differences n their studies (Chubb and Moe, 1990a; Coleman and Hoffer, 1987; Coleman, Hoffer and Sally, 1982). More nuanced HSB studies revealed that private schools have productive and good academic climate (Bryk , 1993). A study conducted by Lubienski and Lubienski (2006) using National Assessment of Educational Progress (NAEP) data revealed that there was a smaller higher Mathematics achievement of students from public schools than privates school from similar geographical areas. Braun, Frank and Wendy (2006) study also revealed similar results with that of Lubienski and Lubienski (2006). Some studies also revealed that the way private schools are structured bring about good learning outcomes from private schools (Lubienski, Crane, and Lubienski 2008; Reardon, Cheadle, and Robinson 2008; Scott., Donald, Judith and Steven, 1995; Taningco, 2006). Many of these studies only conducted studies on how achievement of students were influenced by school type but never focus on rate at which education differ. Many studies also suggested that school type makes school practices differ (Alt and Peter 2002; Chandler 1999, Benveniste, 2003). The cited studies also revealed that school sector and social class have more influence on school practices and school climate.

2.3.5.1 Achievement Differences and School Type

Anderson and Resnick (1997) and Choy (1997) argued that public schools usually have high number of students than private schools and while Darling-Hammond (2000) also discovered that the school with low number of students usually has higher students' achievement than school with higher number of students. In a study conducted by both Finn and Voelkl (1993), revealed that there was a correlation between class size and students good learning environment and greater participation Some researchers argued that the relationship class size and students' achievement was relative because it varies from rural to urban, therefore, it is complex to determine (Howley and Howley, 2004 ; Lee ,2004).

2.3.5.2 Achievement Differences and Class Size

The studies have rebealed that smaller class improves students' achievement (Finn and Achilles 1999; Krueger and Whitmore 2001; Mosteller 1996) while Hanushek (1999) and Hoxby (2000) studies proved otherwise. Smaller classes are very expensive to operate in schools because it is too expensive to run and it is politicized. According to National Center for Education Statistics (NCES) private schools usually have smaller students in class than public schools. It is because of class size that some parents that can afford the cost of private schools, prefer pivate school over public schools.

2.3.6 School type and Attitude to Mathematics

Different studies have correlated the students achievement in Mathematics to different variables (Yan and Lin 2005; Adeyinka and Kaino 2012). A study revealed that there are some factors that affect students' achievement and attitude to Mathematics (Walberg and Tsai, 1985). Those factors are categorised as environmental, mode of instruction and aptitude factors. The way in which those factors stated affected one another to determine students' attitude and achievement in Mathematics still remain focus of researchers in the field of Mathematics Education. Nevertheless, some researchers made wrong assumptions about those variables that affect students' learning outcomes in Mathematics, simply because they failed to study the relationships at performance niches through the continuum. Adeyinka and Kaino (2012) agreed that there are different definitions of attitude by different scholars. Attitude is defined as consistent response of learners based on a particular given stimuli which can be easily differentiated from other existing stimuli based on the mode of evaluation (Adeyinka and Kaino, 2012). According to Yan and Lin (2005), attitude is a disposition that can be learnt and has potential strength to direct and guide behaviuor. Aiken (1976) deciphered that the learners' attitude to Mathematics is a product of learners' personality factors such as value, confidence, motivation and enjoyment. DeFleur and Westie (1963) argued that attitude is a construct that could not be defined uniformly among researchers in the behavioural science field. A study conducted by (Olson and Mitchell 2000) seen attitude as relative students constant predisposition as regard certain subject and also defined attitude as students personal internal evaluation of the subject. A study revealed that learners' attitude to an object is correlated to learners' response toward such an object (Ajzen and Fishbein, 1977). The researchers noted the relationships among each of attitude, beliefs, and intention to behaviours. According to Ajzen and Fishbein (1977) there was no significant relationship between attitude and behaviour. Meanwhile the researchers in the field of Mathematics education find attitude very important in determining students' achievement in Mathematics (Betz and Hackett 1983; Ma and Kishor 1997). Motivation of students to study Mathematics determines the level at which they can commit their time in spending extra hours after class to learn more of Mathematics (Betz and Hackett 1983; Ma and Kishor 1997). DeFleur and Westie (1963) defined motivation as students' internal process that comes up as a result of some stipulated needs. The value students place on Mathematics is determined by their desire needs and kind of benefits they will derive if their needs are meant. Subsequently, students' personal expectation and desire to choose career that will be financially rewarding which relate to Mathematics, improves students motivation to learn Mathematics. Based on Opyene- Eluk and Opolot-Okurut (1995) findings, students can improve their attitude toward learning of Mathematics if they discover that finding good high paying job will not be possible if their knowledge of Mathematics is low. Walberg and Tsai (1985), explained attitude as willingness of an individual to work persistently to learn a particular task. This restless effort may as a result of expected outcomes that will be rewarding if the task is properly completed (Ma and Kishor, 1997). The value students placed on the learning of Mathematics determines their achievement in it (Fuligni and Stevenson, 1995). Nevertheless, it is possible for a student not to value Mathematics but strong to just succeed in it because he/she sees Mathematics as necessary to be passed and condition for further studies.

Confidence is considered as one of determinates of students' attitude to achievement in Mathematics. Some studies emphasized on the parental engagement in their children learning experiences in school (Hill, Castellino, Lansford, Nowlin, Dodge, Bates and Pettit, 2004; Yan and Lin 2005). The rate of parental involvement in school experiences of their children could improve students' attitude to Mathematics if parental involvement makes Mathematics interesting subject to the learners and this could lead to an improvement in students' achievement in Mathematics. It is likely reasonable to think that socio-economic status of the parent can affect students' academic performance. A study conducted by Fuligni and Stevenson (1995) revealed that both behaviour and attitude of the students have significant effect on students achievement in Mathematics among immigrant families in the United State of America. The study linked the performance of immigrants children to their parental socio-economic status. Conversely, another study conducted by Hill (2004) and Yan and Lin (2005) revealed that socio-economic status of the parents is not tenable enough to justify the variance of academic performance of the students. It is possible for socio-economic status of the parent determines the students extra hours spend on their private studies at home, even the time each student spends to do homework as well.

Trautwein (2006) In Dettmers (2010) built a model that based on homework. The rate at which learners' pay attention to homework was significantly related to student belief and motivation. The study has revealed that the amount of hours or time students separate to study after school hour determines their achievement in Mathematics (Fuligni and Stevenson 1995). The study further stressed that the Chinese learners usually separated extra hours to study after school hour than their American students' counterparts (Fuligni and Stevenson 1995). The researchers also agreed that the extra hours spent on studying after school period improves students' achievement. This implies that the quality time spent after school hour along with people who assist them as regard their studies at home could improve students' academic achievement after school. This kind of help or support could be possible from learners' various home (Fuligni and Stevenson 1995) as parental involvement in their children learning at home could improve students' achievement in school. Yan and Lin (2005) study revealed that students' attitude could be influenced by parental involvement in their studies. Finally, the study revealed that high school students will perform better if their parents establish good rapport with them and also encourage them to do better. The findings of this study also revealed that parental engagement and close parent-children relationship are significant to determine students' achievement in Mathematics.

Walberg and Tsai (1985) affirmed that apart from attitude, good mode of quality instructional classroom experience, both classroom and home social group could be significant to students' academic achievement. Meanwhile, in another study school environment and home were considered apart from attitude as factors that could predict students' achievement (Simpson and Steve Oliver 1990). In another way round, both peers' attitude and classroom environment were linked to students' achievement in science. It is also important to look into influence of school type (public and private) on students' achievement in Mathematics because students' achievement may be difference as a result of diverse learning experiences from both public and private schools. The learning experiences are not the same because of differences in the mode of instructional quality from the two types of school (public and private) despite the fact that the same set of syllabus are made available to both students in private and public schools as well. In another way round, public schools are usually less expensive than private schools. It could be deduced that students from private schools usually favoured by both home and school environment better than their counterpart from public schools. The students from private school usually have quality academic supports especially from their parents because most of those parents are educated. Besides, most of these children have access to balance diet, these two conditions can have significant impact on students' academic performance (Symons, Cinelli, James and Groff, 1997). Also, students' achievement in Mathematics could be influenced by teaching behaviour (Evertson, Anderson, Anderson and Brophy, 1980).

On the other hand, the findings on relationship of achievement and attitude are mixed. Hill et al. (2004) affirmed that students' achievement at both middle and elementary school could be influenced by parental involvement while previous research showed that there was no relationship between parental involvement and students' achievement at elementary level. The findings revealed that the effect of parental involvement was relative and determined by ethnicity differences, and also by level of parental education (Hill et al, 2004). Aiken (1976) study revealed that attitude to Mathematics by students could be possibly learnt. He also cited Leake (1970) whose study affirmed that there were complex relationships amongst course content; student and teacher characteristics, instructional materials; method of instruction; peer and parental support affect students' attitudinal changes. Aiken (1976) study revealed that there was a need for appropriate statistical techniques to analysis interactions among those variables. Students' attitude to and achievement in Mathematics are analysed by different studies through the use of regression analysis which is referred to as classical Ordinary Least Square Regression (LaRocque, Kleiman and Darling 2011; Walberg and Tsai 1985). The area of omission that needs to be considered in studying relationship is that part of the studies that failed to examine the multivariate modeling of the relationship which also went further to analyse the complex interactions at various stages of achievement. Some researchers in previous studies assumed that learners have the same experience as regard web of complex interaction and this is the same to all levels of students' achievement. The Ordianry Regression analysis assumes the same slope across the continuum of achievements of students. This implies that the result from the analysis showed a generalized relationship among interrelated variables to students' academic achievement. Both attitude and achievement are normal distributed in past or previous model assumptions. This implies that what happened at the both extreme lower tail and upper tail are the same. According to Koehler (1990) and Hao and Naiman (2007), the Quantile Regression (QReg) explained differences in relationship between dependent and independent variables at the two extremes tails. Adeyinka and Kaino (2012), Cade and Noon (2003), Jing, Daoji and Yuanyuan (2008) affirmed that this method of analysis has been commonly made use of in environmental sciences, actuarial sciences and finance. The following researchers made use of this statistical techniques in researches related to education: Adeyinka and Kaino (2012) and

Jing, Daoji and Yuanyuan (2008) . In addition to this, most of the research analysis are usually parametric in nature. The Ordinary Regression analysis may not be appropriate once basic assumptions of parametric are not followed. Again, QReg provides another way to modeling a relationship among variables once basic parametric conditions are not taken into consideration and also when the researcher has interest in the model at performance niches of theoretical interest.

2.3.7 Gender and Achievement in Mathematics

It has been found that both in abilities and performance in Mathematics males are usually favour than females generally. Uduosoro, (2000) study revealed that female students usually have Mathematics anxiety than their male counterpart. Abilities have been considered as a factor that influence learners' views of Mathematics and even teachers' perception of students' success. In the work of Robinson (1996) cited by Udousoro (2000) on structure of children's abilities reported that females perform as well as males from primary to junior secondary school. Meanwhile as they progress to senior school, females were considered as a gender that lacks self-confidence, therefore, they were not motivated to perform better in the subject. They were not even encouraged to choose good courses at the senior school. It is not that only the teacher that see female with lower confidence but they too see themselves so as regard their mathematical abilities. Studies have shown that the female mathematical abilities are the same as their male counterpart when they were at the primary level but as soon as they get to secondary school, their mathematical abilities reduce. Female usually perceived themselves as having lower mathematical abilities than their male counterpart.

2.3.8 Gender and Attitude to Mathematics

A study conducted by (Fennema, 1990) affirmed that teachers possess some theories and certain belief perspectives that affect their actions, plan and perceptions that tell much on how they organise their classroom environment. Again, Good and Findley (1985) explained that once the attitude of an individual is guided by certain values, belief and principles, it therefore noted that it is possible that teachers' sex related beliefs about learners could affect the way they organise their classroom environment. This implies that the teachers' perspectives or beliefs have way of affecting their classroom attitude or behaviour and this could be critically examined on how their held beliefs could affect students' achievement. Study has identified differences in teachers' interactions with male and female students (Leder and Fennema, 1990). Taole, Zonneveld and Nkhwalume (1993) study revealed that teachers usually interact with male students than female counterpart because male students are usually being scolded, praised and called to send on an errand than female students in particular. However, the reasons and effects of this difference in treatment between male and female students could not be explained or ascertained.

No study correlated differences in treatment of both male and female students with male and female differences in Mathematics achievement (Eccles and Blumenfeld, 1985; Koehler, 1990). Meanwhie Fennema and Peterson (1986) study revealed that little differences in behaviour of teachers coupled with how teachers organized their mode of instruction defined the system at which classroom structure favours male performance in Mathematics. Take for example, competitive learning activities do not favour female student but favour male students while cooperative activities makes female students more favoured than male students. Inasmuch that classroom activities is more of competitive than cooperative, Since competitive activities were much more prevalent than cooperative activities, it appear therefore, the classroom learning environment favours male than female. Fennema and Peterson (1985) suggested learning that based on autonomous learning behaviours model which revealed that societal impact in which teachers and classroom environment formed the basic component couple with individual personal belief which relates to lowered self-confidence, belief system in usefulness and style of attribution, do not allow female students to engage in learning to make them become independent learners of Mathematics. The model worked well with Botswana students while some may believe that for female to attain self-independent in Mathematics will require them to work in cooperation with other students to solve mathematical problems together and this will also improve their critical thinking as well.

It is difficult to discover about factors or variables that could contribute to Mathematics achievement differences among genders. Some researchers believe that variables that contribute to gender differences in Mathematics achievement are yet to be evident and there is no good justification that teachers' differences in treatment of male and female students contribute gender differences in Mathematics achievement. America organized programmes to train teachers on how they can know differences between male and female and also on how both male and female can be treated differently. Fennema, (2000) study revealed that this intervention programmes in America failed to remove male and female differences in Mathematics achievement. Teachers' differences in treatment of male and female in Botswana (Taole, Zonneveld and Nkhwalume, 1993) are just a very small case out of many cases of various reasons for male and female differences in Mathematics achievement.

2.4 Appraisal of Literature Review

Literature reviewed revealed that Interactive e-note and Problem solving are powerful medium through which learners' interest in Mathematics can be enhanced. Literature reviewed also indicate that despite several suggestions from various scholars and researchers on the need for Mathematics teachers to embrace Interactive e-note to enhance their teaching of Mathematics, yet there is little or no conformity to this laudable idea in Nigeria secondary schools. The review also stressed the fact that where Interactive e-note approach was employed by Mathematics teacher there was an increase in students' class attendance vis-a- vis active class participation. It also pointed out that students would learn better when Interactive e-note and problem solving strategies are adopted in Mathematics teaching in addition to the fact that both strategies were learner centered.

Finally, ICTs has been seen by different researchers in the literature as a way of improving learning in different areas such as learning of programme, subject and personal learning which has also led to the use of new methods of learning through information communication and technology by dint of data bases, simulation, modeling, closed-word exploration, guided discovery and so forth. ICTs has brought inevitable changes in the area of instructions, teaching strategy, organization of curriculum and instruction contents and the role teacher plays in lesson delivery. ICTs embedded Pedagogical instruction has benefits of improving; motivation, recalling of what have been learnt previously, new instructional stimuli, learner response, systematic and consistent feedback, students engagement in appropriate practice, orderliness in learning appropriately and providing diverse viable source of information for improving learning. Any teacher who makes use of information communication and technology in the mode of instructional delivery has tendency of improving students' use of ICTs for their personal use as well. Meanwhile, this can improve learners' problem solving skill, self-efficacy and as well as self-confidence.

CHAPTER THREE

METHODOLOGY

In this chapter, research design, variables of the study, selection of participants, sampling and sampling techniques, research instruments and research procedures were explained in details.

3.1 Research Design

This study adopted the pretest-posttest control group quasi-experimental design involving a 3 x 2 x 2 factorial matrix. The design had treatment at 3 levels crossed with the student's school type at two levels (private, public) and gender (male, female) at two levels. The design is represented thus:

$0_1 X_1 0_4$	-	Experimental Group 1
$0_2 X_2 0_5$	-	Experimental Group 11
$0_3 X_3 0_6$	-	Control Group

Where 0_1, 0_2 and 0_3 represent the pretest for two experimenter groups and a control group and 0_4, 0_5 and 0_6 represent the posttest for the experimental and control groups.

i. X_1 = represents Treatment 1for group 1 involving Interactive e-note Mathematics Instruction Strategy (IMIS)

ii. X_2 = represent Treatment 11 involving Problem solving instructional Strategy (PSS)

iii. X_3 = represent control group involving the use of Conventional Teaching Strategy (CTS)

Table 3.1: 3 x 2 x 2 Factorial Matrix

Group	Gender	School Type	
		Private	Public
Interactive e-note Mathematics Instruction Strategy (IMIS)	Male		
	Female		
Problem solving instructional Strategy (PSS)	Male		
	Female		
Conventional Teaching Strategy (CTS)	Male		
	Female		

3.2 Variables of the Study

Variables of the research include

a. The independent variable: is instructional strategy manipulated at three levels.

   i. Interactive e-note Mathematics Instruction Strategy (IMIS)

   ii. Problem Solving Strategy (PSS)

   iii. Conventional Teaching Strategy (CTS)

b. Moderator Variables are

   i. School Type (Private and Public)

   ii Gender (Male and Female)

c. Dependent Variables are:

   1 Achievement in Mathematics

   2 Attitude to Mathematics.

3.3 Selection of Participant

All junior secondary schoolsthat is JSI located in Kaduna state form the major participants in this study. This JSI class is more suitable for this study because their class or level form the foundation of secondary school education where the necessary skills for learning Mathematical concepts via interactive e-note and problem solving would be developed. Apart from this, this class level of students takes their time to involve in the experiment in this study easily because their class level does not prepare for external body examination.

3.4 Sample and Sampling Technique

Three private and three public secondary schools were purposively selected from Kaduna North and Kaduna South Local Government areas of Kaduna State for this study based on certain criteria stated below:

(i) The schools must be far apart from one another in terms of geographical location to prevent students' interactions across treatments used.

(ii) Availability of computer facilities like computer laboratory with functional computer systems in the school or possession of lap top computers by the students in the school.

(iii) Availability of electricity or stand by generator in the schools to be selected.

(iv) Must be a co-educational school.

Among the schools that met up with the stipulated criteria, purposive sampling technique was used to select six schools to participate in the study, that is, three private and three public schools were selected. In each of the six chosen secondary schools, two intact classes were randomly selected and assigned to the experimental and control groups accordingly. A total of 400 JS1 students comprising boys and girls took part in the study.

3.5 Research Instruments

The following research instruments were used in the study

1. Mathematics Achievement Test (MAT)
2. Student Attitude towards Mathematics Questionnaire (SAMQ)
3. Interactive e-note Mathematics Instruction Strategy (IMIS)
4. Instructional Guide for Problem Solving Strategy (IGPSS)
5. Instructional Guide for Conventional Teaching Strategy (IGCTS)
6. Teachers Evaluation Sheet (TES) for:

(a) Interactive e-note Mathematics Instruction (IMIS).

(b) Problem Solving Strategy (IGPSS).

(c) Conventional Teaching Strategy (IGCTS).

7. Validation Sheet (VS) for Interactive e-note Mathematics Instruction Strategy (IMIS)

3.5.1 . Mathematics Achievement Test (MAT)

Students achievement in Mathematics was measures by 30 item of multiple choice objective test that have up to four options A to D from which JSI students are to pick one correct answer.It covered the content of some topics in JSS one Mathematics curriculum. These topics were selected based on the recommendations of Akanni (2015) on perceived difficult topics in Mathematics. The instrument made up of two section which were section A and B. Section was to elcit personal information about the respondents such as school type, gender, name of students and school. Section B made up of 30 items of multiple choice that were drawn from the selected Mathematics concepts for this study experiment. Students' knowledge, understanding and thinking were measured through this instrument. Out of the 30 items, 8 belong to the lower level cognitive questions (knowledge) while 22 covered higher level cognitive questions of understanding and thinking. Scoring was done by awarding one mark to each question answered correctly, which gave a maximum of 30 marks.

Table 3.2: Table of specification for Mathematics Achievement Test

Topic	Knowledge	Understanding	Thinking	Total
Approximation	(1,10,22)3	-	(5,9,17,21)4	7
Number Bases	(23)1	(3,19)2	(2,18)2	5
Basic Operations	(4,24)2	(7)1	(6,16,25)3	6
Algebraic Process	(11,27)2	(8,12,13,14,15,26,29 ,30)8	(20,28)2	12
Total	**8**	**11**	**11**	**30**

Two Mathematics teachers that are teaching junior secondary schools Mathematics were involved in both content and face validity of the instruments. Those two set of teachers were selected from schools that are not meant to involve in the study. The main reason for face and content validity of the items were to ensure that the instrument is more appropriate for the JSI students. This test was then trial tested on students from both private and public secondary school who were not part of the study. The reliability index of 0.87 was obtained using Kuder-Richardson formula (KR – 20). The item difficulty index ranges between 0.4 and 0.7.

3.5.2Student Attitude towards Mathematics Questionnaire (SAMQ)

This is a 30 items Mathematics attitude scale adapted from Fennema – Sherman 1976 Mathematics attitude scale. The questionnaire was designed to elicit information from the students on their attitude towards Mathematics learning. It consists of two sections. Section A deals with the biodata of the candidates such as name, sex and school type. Section B consists of 30 items which were made up of both positively and negatively worded items. It is a four point Likert rating scale of Strongly Agree (SA), Agree (A), Disagree (D), and Strongly Disagree (SD) and was scored as 4,3,2,1 respectively. The negatively worded questions in the instrument are reversed. JSI students from schools that are not meant to be part of the study were selected for the revalidation of the instrument. Cronbach Alpha was used to measure the reliability coefficient of the instrument and the value was found to be 0.79 which showed an internal consistency.

3.5.3 Guide on Interactive e-note Mathematics Instruction Strategy (IMIS)

Text, sound, graphics and animation were used to prepare the e-note Mathematics instructional package. The material was prepared by the researcher. The package is a step by step instruction from simple to complex activities covering a total of eight weeks. The material introduces the concepts been taught on selected topics of junior secondary school one Mathematics curriculum after which the students are required to attempt the class work. The package provides an immediate feedback or reinforcement which showed whether or not the students' response was correct. The student would have Immediate Knowledge of Result (IKOR) where the learner response is correct, the system awards one mark and no mark for wrong response. The features of the e- note components includes (i) zoom in and out buttons (ii) Back and forward arrow keys (iii) First and last page arrow keys (iv) Table of contents icon (v) Share icon (vi) Print icon (vii) Search icon (viii) Help icon (ix) Enable full screen icon (x) Select text icon (xi) side bar arrow keys (xii) Thumbnails (xiii) Auto flip (xiv) Sound on/off (xv) Switch Language (English) (xvi) Social share (either on Face book or Twitter or Google^{+}) and (xvii) Page indicator. These features with the graphics embedded to stimulate student interest in learning Mathematics make the e-note interactive. The package can work offline and can be deployed on line if internet facility is available.

The interactive e-note Mathematics instructional package was validated by professional from educational technology department and lecturer in Mathematics unit, Department of Science and Technology Education, University of Ibadan using the validation sheet. The instrument has two sections. The first section contains information on date, evaluator, school/position software title and subject area while the second section contains evaluation check list covering 66 items on content, ease of use, ability levels, interactivity ,assessment, technical quality, fun and adaptability. This was used to validate the Interactive e-note Mathematics Instruction package. The validated package was trial –tested on 20 JS1 students (10 from private and 10from public secondary respectively) outside the sample for the main study after which the final version was produced. The responses of validation from both the professional from educational technology department and lecturer from Mathematics Education unit, Department of Science and Technology Education University of Ibadan were used in calculating the reliability coefficient (Scot pi) which gave a value of 0.81.

3.5.4. **Instructional Guide for Problem Solving Strategy (IGPSS)**

This is a problem solving instructional package designed to teach Mathematics in junior secondary school class one. It is a text assisted linear self-instructional package. There are 17 lessons consisting of 3 – 5 frames per lesson in the package. The lessons are designed for 8 weeks, of which 7 weeks has two periods each while week 8 ends with a period.

Each frame poses a question and the answer is given on the indicated page. The teacher will assist in the use of the package and a student who is in doubt is free to ask for the teacher assistance. Each lesson (frames) can be completed within the normal class period assigned for it in the package

The draft of the guide was given to some Mathematics teachers in junior secondary school. Their comments were taken into consideration in preparing the final copy of the guide. The reliability coefficient of their responses was calculated using inter-rater reliability which gave a value of 0.83**.**

3.5.5Instructional Guide for Conventional Teaching Strategy (IGCTS)

The guide shows the instructional strategy for the control group. Its procedures include introduction, discussion and evaluation.

The draft of the guide was given to some Mathematics teachers in junior secondary school. Their comments were taken into consideration in preparing the final copy of the guide.

The reliability coefficient of their responses was calculated using inter-rater reliability which gave a value of 0.81.

3.5.6 Teachers Evaluation Sheet (TES) for Interactive e-note Mathematics Instruction (IMIS), Problem Solving Strategy (IGPSS) and Conventional Teaching Strategy (IGCTS)

This was used to evaluate trained research assistant effective use of instructional guides; Interactive e-note), problem Solving Strategy and conventional teaching strategy. The instrument has two sessions. Section A contains information such as name of school, instructional strategy used, class, number of students and number of periods the strategy was used. Section B was made up of the different stages of the instructional strategy assessed.

3.6 Research Procedure

A letter of introduction from the Department of Science and Technology Education, University of Ibadan was obtained and presented to the principalsof the participating schools to obtain their permission to use their schools for the study. The following time schedule was used for the study;

First and second week were for training of research assistants.

Third week was designed for the pretest instrument administration for the participants.

Fourth to eleventh week (8 weeks) were for the treatment and follow-up.

Twelfth week was for the posttest administration.

3.6.1. Training of Research Assistants

The cooperation and support of the teachers and school principals were sought. The researcher discussed with Mathematics teachers in the six schools involved and told them that the students should not be noticed that they are used for the study. The administration of pretest (Mathematics Achievement Test and Students Attitude towards Mathematics Questionnaire) was done in the third week. JS1 Mathematics teachers from each of the six schools were given training in the use of strategies appropriate for their group for two weeks. The training was in stages. The first stage was to prepare the teachers on how to use the interactive e-note and problem solving instructional packages. The researcher then demonstrated how to use the instructional packages to the teachers and later asked them to do the same. From the two local government selected for this study, one private and one public schools will be randomly selected for each of the strategy in the study. Hence each Local Government Area represented each of the groups that is interactive e-note Mathematics instructional strategy, problem solving instructional strategy and conventional teaching strategy.

The teachers for experimental group I was provided with interactive Mathematics e-note package prepared by the researcher for installation into the students lap top/ school server. While the teachers for experimental group II were provided with the problem solving instructional package guide. The teachers for the control group also received prepared guide for the conventional teaching strategy having the same contents as in the two experimental groups. Since the classes were handled by the teachers the students believed that they were receiving their normal lesson. After the administrations of the pretest and necessary materials had been given to the teachers, the teaching commenced and lasted 8 weeks. The researcher went round to monitor the teaching session. At the end of the instruction, the pretest instruments were used as posttest to all groups to measure the learning outcomes that had taken place. The experiment covers a total of 12 weeks.

3.6.2. Administration of Pretest

Pretest for the study was administered in the third week to the entire Junior Secondary School 1 students' who participated in the process as follows;

(i) Mathematics Achievement Test (MAT),

(ii) Student Attitude towards Mathematics Questionnaire (SAMQ)

3.6.3. Treatment Procedure

Eight weeks (4^{th} – 11^{th}) were used for the implementation of the treatment for each of the two experimental groups. Three treatment groups each representing a teaching strategy were involved in the study. These are Interactive e-note Mathematics Instruction Strategy (IMIS), Problem Solving Strategy (PSS) and Conventional Teaching Strategy (CTS).

3.6.3.1 Experimental Group 1: Interactive e-noteMathematics Instruction Strategy (IMIS).

Steps for Interactive e-note Mathematics Instruction Strategy Guide (IMISG)

Step i. Teacher demonstrates how to use the package to the students after installations.

Step ii Students follow the guide lines on the user manual on lesson accessibility.

Step iii. Students go through the lesson and solved examples in the package while the teacher observes them

Step iv. Students' ask questions while the teacher listens and answers.

Step v. Students copy the note from the computer to act as a backup in-case of battery discharge, file corruption or computer damage.

Step vi. Teacher evaluates by giving students class and home work.

Step vii. Students are instructed to go through the next lesson frame, jot down their question(s) to form the basis of discussion in the next Mathematics lesson by the teacher.

3.6.3.2 Experimental Group 11: Problem Solving Strategy (PSS)

The following steps were followed by the students when using problem solving strategy

(i) Students read through a page (frame)

(ii) Students write down their answer to a question from a frame on a separate sheet of paper

(iii) Students check the answer to a frame on the indicated page before reading the next frame.

(iv) Teacher acts as a guide during the lesson

(v) Students return the package to the teacher after each lesson.

The package is not a test so read the questions carefully before attempting the answer

3.6.3.3 Control Group: Teaching Strategy (IGCTS)

Steps for Instructional Guide on Conventional Teaching Strategy are:

Step i. Teacher introduced the lesson to the students.

Step ii. Teacher discussed the content of the lesson using the guide with the students.

Step iii. Teacher directed the students to copy examples from the chalk board.

Step iv. Teacher evaluated by giving the students class and home work.

3.6.4. Administration of Posttest

The twelfth week was used for the administration of posttest for the entire participating students' across the schools in the following order:

(i) Mathematics Achievement Test (MAT),

(ii) Student Attitude towards Mathematics Questionnaire (SAMQ)

3.7 Method of Data Analysis

The data were analysed using descriptive statistics and the hypotheses formulated were tested at $p \leq 0.05$ using Analysis of Covariance, Bonferrroni post hoc test and estimated marginal mean

CHAPTER FOUR

RESULTS AND DISCUSSION

The results in this study are presented and discussed in this chapter in line with the formulated hypotheses.

4.1 Presentation of Results

Hypothesis 1a:There is no significant main effect of treatment on students' achievement in Mathematics

Table 4.1 Analysis of Covariance of Achievement by treatment, school type and gender

PostAchievement						
Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	5537.053[a]	12	461.421	93.093	.000	.744
Intercept	1209.151	1	1209.151	243.951	.000	.388
PreAchievement	1904.949	1	1904.949	384.331	.000	.500
Treatment	69.523	2	34.762	7.013	.001*	.035
Schooltype	136.948	1	136.948	27.630	.000*	.067
Gender	5.032	1	5.032	1.015	.314	.003
Treatment * Schooltype						
Treatment * Gender	121.241	2	60.621	12.230	.000*	.060
Schooltype * Gender	3.527	2	1.763	.356	.701	.002
Treatment * Schooltype	2.343	1	2.343	.473	.492	.001
* Gender	1.482	2	.741	.150	.861	.001
Error	1908.266	385	4.957			
Total	179661.000	398				
Corrected Total	7445.319	397				

a. R Squared = .744 (Adjusted R Squared = .736).* depict significant at 0.05 level of significance

Table 4.1 shows that treatment had a significant main effect on students 'achievement in Mathematics ($F_{(2,385)} = 7.01; p<0.05; \eta^2=0.04$). Therefore, the null hypothesis 1a is rejected. This indicates that the treatment had main effect, that is, significant on achievement of students in Mathematics and this comes with 4.0% effect size. In order to determine the direction of significance, Estimated marginal means and Bonferroni post hoc analysis was computed for the pair wise comparison of the posttest achievement mean score of the treatment groups.

Table 4.2 Estimated marginal means of Mathematics posttest achievement according to treatment

Post Achievement

Treatment	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Interactive e-note	21.481[a]	.213	21.062	21.901
Problem Solving	20.299[a]	.218	19.870	20.728
CIS	20.415[a]	.222	19.978	20.852

a. Covariates appearing in the model are evaluated at the following values: PreAchievement = 15.6382.

Table 4.2 shows that students exposed to interactive e-note instructional strategy had the highest posttest achievement mean score ($\bar{x}$=21.48) followed by those exposed to the conventional instructional strategy ($\bar{x}$=20.42) and the least posttest mean score was obtained by those exposed to problem solving strategy ($\bar{x}$=20.30)

Table 4.3 Bonferronni Pairwise Comparison of the treatment groups

PostAchievement						
(I) Treatment	(J) Treatment	Mean Difference (I-J)	Std. Error	Sig.[b]	95% Confidence Interval for Difference[b]	
					Lower Bound	Upper Bound
Interactive e-note	Problem Solving	1.182*	.333	.001	.381	1.983
	CIS	1.066*	.339	.005	.252	1.880
Problem Solving	Interactive e-note	-1.182*	.333	.001	-1.983	-.381
	CIS	-.116	.291	1.000	-.815	.583
CIS	Interactive e-note	-1.066*	.339	.005	-1.880	-.252
	Problem Solving	.116	.291	1.000	-.583	.815

Based on estimated marginal means

*. The mean difference is significant at the .05 level.

b. Adjustment for multiple comparisons: Bonferroni.

Table 4.3 shows that the posttest achievement mean score for those students who were taught through interactive e-note strategy was significantly different from those exposed to conventional instructional strategy and problem solving instructional strategy respectively. On the other hand, the posttest achievement mean scores of students exposed to conventional instructional strategy was not significantly different from those exposed to problem solving instructional strategy. This could be noted from Table 4.1 that showed the significant main effect of the treatment that was due to the posttest achievement mean scores of students exposed to the interactive e-note.

Hypothesis 1b: There is no significant main effect of treatment on students' attitude to Mathematics

Table 4.4 Analysis of Covariance of Students' attitude to Mathematics by treatment, school type and gender

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	28902.096[a]	12	2408.508	74.237	.000	.698
Intercept	18482.754	1	18482.754	569.690	.000	.597
PreAttitude	17351.105	1	17351.105	534.809	.000	.581
Treatment	4246.956	2	2123.478	65.452	.000*	.254
Schooltype	510.316	1	510.316	15.729	.000*	.039
Gender	5.908	1	5.908	.182	.670	.000
Treatment * Schooltype	387.976	2	193.988	5.979	.003*	.030
Treatment * Gender	101.311	2	50.656	1.561	.211	.008
Schooltype * Gender	107.377	1	107.377	3.310	.070	.009
Treatment * Schooltype	86 .759					
* Gender	12490.760	2	43.380	1.337	.264	.007
Error	4144937.000	385	32.444			
Total	41392.857	398				
Corrected Total		397				

*depict significant at 0.05 level of significance

Table 4.4 shows that the treatment had a significant main effect on students' attitude towards Ma $(_{2,385})=65.45; p<0.05; \eta^2=0.254$).. Therefore, the null hypothesis 1b is rejected. This implies that had a significant main effect on students' attitude to Mathematics with an effect size of 25.4% determine the direction of significance, Estimated marginal means and Bonferroni post hoc computed for the pair wise comparison of the posttest attitude mean scores of the treatment group

Table 4.5 Estimated Marginal Means

PostAttitude				
Treatment	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Interactive e-note	105.385[a]	.457	104.485	106.284
Problem Solving	100.348[a]	.524	99.318	101.379
CIS	97.507[a]	.533	96.459	98.554

a. Covariates appearing in the model are evaluated at the following values: PreAttitude = 86.5101.

Table 4.5 shows that students exposed to interactive e-note instructional strategy had the highest posttest attitude mean score ($\bar{x}$ =105.39) followed by those exposed toproblem-solving instructional strategy ($\bar{x}$ =100.35) and the least posttest mean attitude score was obtainedby those exposed to the conventional instructional strategy ($\bar{x}$ =97.51).

Table 4.6 Bonferonni Pairwise Comparison of the treatment groups

(I) Treatment	(J) Treatment	Mean Difference (I-J)	Std. Error	Sig.[b]	95% Confidence Interval for Difference[b]	
					Lower Bound	Upper Bound
Interactive e-note	Problem Solving	5.036*	.696	.000	3.363	6.709
	CIS	7.878*	.708	.000	6.175	9.581
Problem Solving	Interactive e-note	-5.036*	.696	.000	-6.709	-3.363
	CIS	2.842*	.747	.000	1.045	4.639
CIS	Interactive e-note	-7.878*	.708	.000	-9.581	-6.175
	Problem Solving	-2.842*	.747	.000	-4.639	-1.045

Based on estimated marginal means

*. The mean difference is significant at the .05 level.

b. Adjustment for multiple comparisons: Bonferroni.

Table 4.6 shows that the posttest attitudes mean scores of students exposed to interactive e-note strategy is significantly different from that of those exposed to conventional instructional strategy and problem solving instructional strategy respectively. Also the posttest attitude mean scores of those students that were taught through conventional instructional strategy was different significantly from that of those exposed to the problem solving instructional strategy. It was noted from Table 4.4 that revealed a significant main effect of treatment on students' attitude which was due to the posttest attitude mean score of students exposed or taught through the interactive e-note and problem solving instructional strategies respectively. This is further expressed in the estimated marginal mean computed in Table 4.5

Hypothesis 2a: There is no significant main effect of school type on students Achievement in Mathematics

Table 4.1 shows that there was a significant main effect of school type on students' achievement in Mathematics ($F_{(1,385)}=27.63; p<0.05; \eta^2=0.067$) , hence the null hypothesis 2a is rejected. This means that there is effect size of 6.7% due to main effect of school type on students' achievement in Mathematics that is significant. In order to determine the direction of significance an estimated marginal mean was computed in Table 4.7

Table 4.7 Estimated Marginal Means of Students Achievement in Mathematics According to School Type

School type	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Public	20.078[a]	.173	19.738	20.419
Private	21.385[a]	.164	21.062	21.709

a. Covariates appearing in the model are evaluated at the following values: PreAchievement = 15.6382.

Table 4.7 shows that the Mathematics achievement posttest mean scores of students in the private school ($\bar{x}$=21.39) is higher than that of their counterpart in public school ($\bar{x}$=20.08). It can therefore be inferred that the significant main effect of school type is due to the Mathematics achievement posttest mean score of the students in the private school.

Hypothesis 2b: There is no significant main effect of school type on student' attitude to Mathematics

Table 4.4 shows that there was a significant main effect of school type $\{F_{(1,385)}=15.73; p<0.05; \eta^2=0.039\}$ on students' attitude to Mathematics with an effect size of 3.9%. Based on this result the null hypothesis 2b is rejected. This implies that there is a significant main effect of school type on students' attitude towards Mathematics. Estimated marginal means was also computed in order to see the magnitude of means.

Table 4.8 Estimated Marginal Means of Posttest Attitude According School Type

School type	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Public	99.927[a]	.413	99.116	100.738
Private	102.232[a]	.409	101.428	103.037

a. Covariates appearing in the model are evaluated at the following values: PreAttitude = 86.5101.

Table 4.8 shows that students in the private school had a higher posttest attitude mean score ($\bar{x}$=102.23) compared to that of their counterparts in the public school ($\bar{x}$=99.93). This result implies that the main effect of school type is due to the posttest attitude mean score of the private schools students.

Hypothesis 3a: There is no significant main effect of gender on students achievement in Mathematics

Table 4.1 shows that there is no significant main effect of gender $\{F_{(1,385)}=1.02; p>0.05\}$ on students' achievement in Mathematics. Based on this result, the null hypothesis 3a is not rejected. This means that there is no significant main effect of gender on Mathematics achievement of students.

Hypothesis 3b: There is no significant main effect of gender on student' attitude to Mathematics

Table 4.4 shows that there is no significant main effect of gender $\{F_{(1,385)}=0.182; p>0.05\}$ on students' attitude to Mathematics. As a result of this, the null hypothesis 3b is not rejected. This implies that there is no significant main effect of gender on students' attitude to Mathematics.

Hypothesis 4a: There is no significant interaction effect of treatment and school type on student' achievement in Mathematics

Table 4.1 shows that there was a significant interaction effect of treatment and school type ($F_{(2,385)}$=12.23;$p<0.05$;η^2=0.06) on students' achievement in Mathematics. Based on this result, the null hypothesis 4a is rejected. This reveals that there is a significant interaction effect of treatment and school type on students' achievement. This implies that the treatment is sensitive to the school type. In order to understand the direction of significance and which school type benefited more in the treatment groups, estimated marginal mean was computed.

Table 4.9 Estimated marginal means of posttest achievement according to treatment and school type

Treatment	School type	Mean	Std. Error	95% Confidence Interval	
				Lower Bound	Upper Bound
Interactive e-note	Public	21.519[a]	.255	21.018	22.020
	Private	21.444[a]	.314	20.826	22.061
Problem Solving	Public	19.597[a]	.307	18.993	20.201
	Private	21.002[a]	.293	20.426	21.578
CIS	Public	19.119[a]	.326	18.477	19.761
	Private	21.711[a]	.291	21.139	22.283

a. Covariates appearing in the model are evaluated at the following values: PreAchievement = 15.6382.

The table 4.9 shows that students exposed to problem solving ($\bar{x}$ = 21.00) and Conventional instructional strategy ($\bar{x}$ =21.71) in private school had a higher posttest achievement mean scores in Mathematics than their counterparts in public schools. It was only in the interactive e-note that the public schools had a slightly higher achievement mean scores than the private. This might probably be because of the innovativeness of the e-note instructional strategy. Figure 4.1 is a graph of the interaction of school type with treatment.

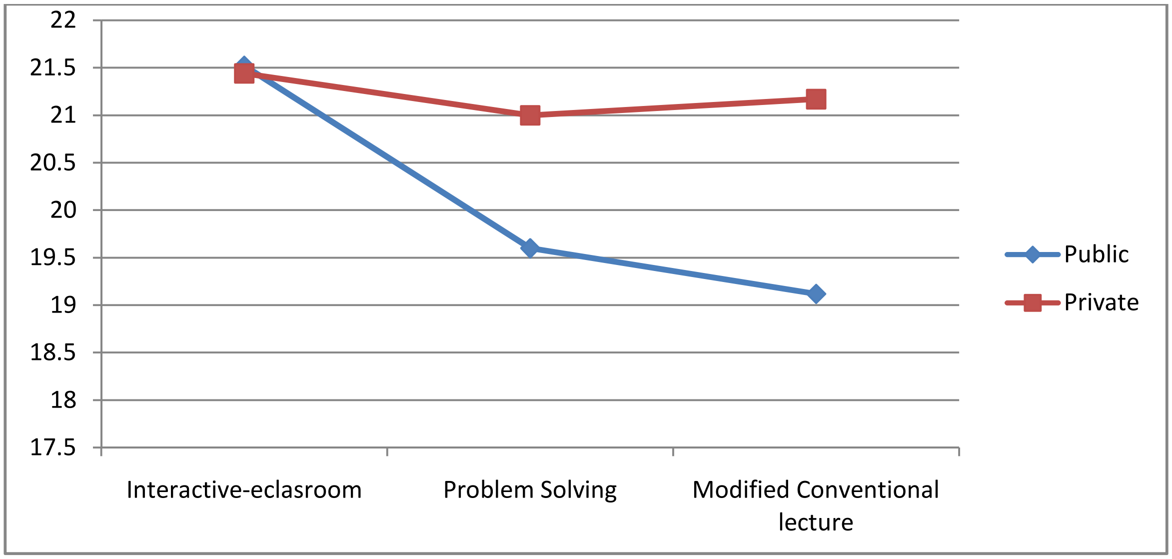

Figure 4.1: Graph of the interaction Effect of school type with treatment

The graph figure 4.1 shows that the interaction effect of treatment and school type on students' achievement in Mathematics is disordinal.

Hypothesis 4b: There is no significant interaction effect of treatment and school type on student' attitude to Mathematics

Table 4.4 shows that there was a significant interaction effect of treatment and school type ($F_{(2,385)}=5.97; p<0.05; \eta^2=0.03$) on students attitude towards Mathematics. As a result of this, the null hypothesis 4b is rejected. This indicates that the effect of treatment on students' attitude towards Mathematics has influence on the type of school. In order to see the interaction effect, the estimated marginal means was computed in table 4.10

Table 4.10 Estimated Marginal means of Post Attitude Treatment by School type

	School type	Mean	Std. Error	95% Confidence Interval	
				Lower Bound	Upper Bound
Interactive e-note	Public	103.071[a]	.641	101.810	104.332
	Private	107.698[a]	.648	106.425	108.971
Problem Solving	Public	100.446[a]	.748	98.975	101.917
	Private	100.250[a]	.740	98.796	101.705
CIS	Public	96.264[a]	.766	94.759	97.770
	Private	98.749[a]	.742	97.291	100.207

a. Covariates appearing in the model are evaluated at the following values: PreAttitude = 86.5101.

Table 4.10 shows that the interaction effect of treatment and school type on the posttest attitude of students in Mathematics was consistently favoured the students in private schools exposed to the interactive e-note ($\bar{x}$ =107.70) and conventional instructional strategy ($\bar{x}$ = 98.749) compared to their counterparts in the public school. It is only those students exposed to the problem solving in public schools that had a slightly higher posttest attitude mean scores ($\bar{x}$ = 100.45) than the students exposed to the same treatment in private school. The graph in Figure 4.2 was computed in order to determine if the interaction effect of treatment and school type is ordinal or disordinal.

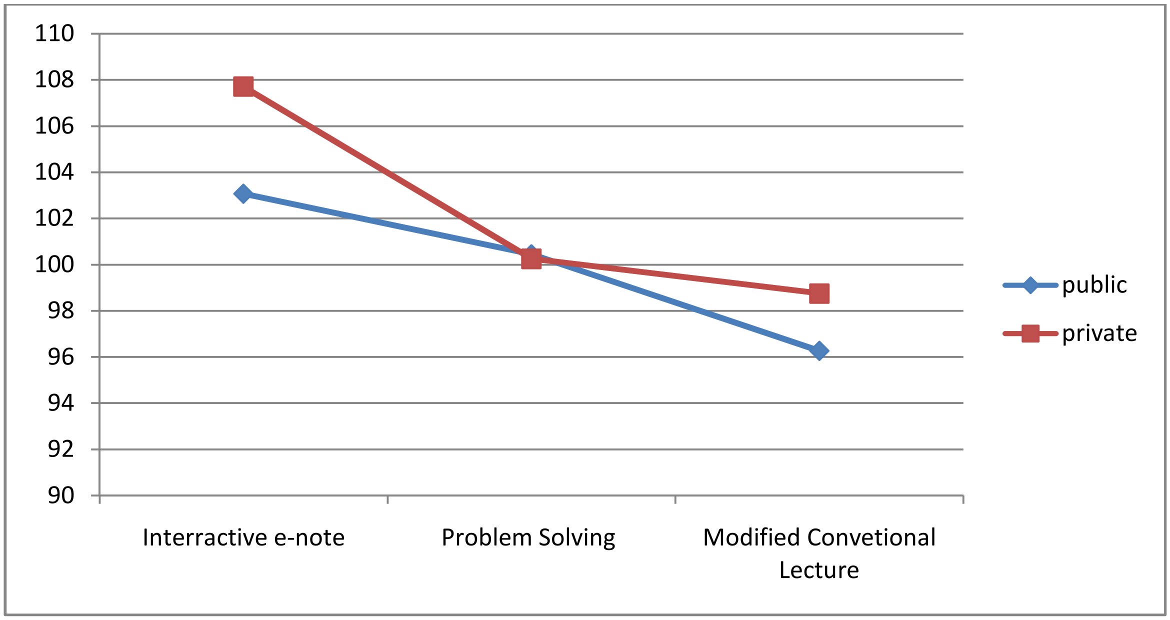

Figure 4.2: **Graph of Interaction Effect of Treatment and School type on Students Attitude towards Mathematics**

The graph in figure 4.2 reveals a disordinal interaction effect of treatment and as well as school type on students' attitude to Mathematics.

Hypothesis 5a: There is no significant interaction effect of treatment and gender on student' achievement in Mathematics

The result in Table 4.1 shows that there is no significant interaction effect of treatment and gender on students' achievement in Mathematics ($F_{(2,385)}$=.356;p>0.05). Therefore the null hypothesis 5a is not rejected. This implies that the interaction effect of treatment and gender on students' achievement in Mathematics is not significant.

Hypothesis 5b: There is no significant interaction effect of treatment and gender on student' attitude to Mathematics

The result in Table 4.4 shows that there is no significant interaction effect of treatment and gender on students' attitude towards Mathematics ($F_{(2,385)}$=1.56;p>0.05). Therefore the null hypothesis 5b is not rejected. This implies that the interaction effect of treatment and gender on students' attitudes towards Mathematics is not significant.

Hypothesis 6a: There is no significant interaction effect of school type and gender on student' achievement in Mathematics

The result in Table 4.1 shows that there is no significant interaction effect of school type and gender on students' achievement in Mathematics ($F_{(1,385)}$=.473;p>0.05). Therefore the null hypothesis 6a is not rejected. This implies that the interaction effect of school type and gender on students' achievement to Mathematics is not significant

Hypothesis 6b: There is no significant interaction effect of school type and gender on student' attitude in Mathematics

The result in Table 4.4 shows that there is no significant interaction effect of school type and gender on students' attitude towards Mathematics ([F $(_{1,385})$ =3.31;p>0.05). Therefore the null hypothesis 6b is not rejected. This implies that the interaction effect of school type and gender on students' achievement in Mathematics is not significant.

Hypothesis 7a: There is no significant interaction effect of treatment, school type and gender on student' achievement in Mathematics

The result in Table 4.1 shows that there is no significant interaction effect of treatment school type and gender on students' achievement in Mathematics ([F$(_{2,385})$=0.150;p>0.05). Therefore the null hypothesis 7a is not rejected. This implies that the interaction effect of treatment, school type and gender on students' achievement in Mathematics is not significant

Hypothesis7b: There is no significant interaction effect of treatment, school type and gender on student' attitude to Mathematics

The result in Table 4.4 shows that there is no significant interaction effect of treatment school type and gender on students' attitude in Mathematics (F$(_{2,385})$=1.34;p>0.05). Therefore the null hypothesis 7b is not rejected. This implies that the interaction effect of treatment, school type and gender on students' attitude to Mathematics is not significant

4.2 Discussion of Findings

4.2.1 Main Effect of Treatment on Achievement and Attitude in Mathematics

The findings of this study showed that the main effect of treatment on students' mathematics achievement is significant and this main effect is largely due to the posttest achievement of those students who were exposed or taught through the interactive e-note instructional strategy. This is probably as a result of the learners' interest and excitement which the strategy aroused among students exposed to it. The strategy also allows a great deal of interaction among the students. The findings of this study on achievement corroborates that of Sara (2012) who found that college students taught by interactive multimedia had greater long – term retention compared to students taught by traditional classroom methods. Sara (2012) also established that, the students learning with help of the interactive e-note fared better in

Mathematics than the students learning through the conventional instructional strategy. Also the results of this study in agreement with that of Battulga, Koushi, Tamura and Moriguchi (2012) which showed that the interactive 3DCG model is effective in undergraduate medical education in terms of achievement and enhanced the motivation of medical students; although Battulga etal (2012) used interactive e-class as a supplement to instruction. Similarly, the findings of the study showed that main effect of treatment on students' attitude is significant. The significant main effect was largely attributed to the interactive e-note and problem solving strategies. Although, students exposed to interactive e- note had a better attitude than those exposed to problem solving strategy. The interactive e-note strategy must have improved students attitude significantly, because the students are technological natives and information technology is part of their everyday life. So teaching the students through what they are used to affected their attitude in a positive way. Problem solving instructional strategy also improved students' attitude in Mathematics. The findings of this study is in accord with that of Getumo, Kiboss, Changeiywo and Ogola (2015) who found that the main effect of interactive e-learning module on students' attitudes in an electronic class is significant.

4.2.2 Main Effect of School Types on Achievement and Attitude in Mathematics

The result of the findings showed that the main effect of the school type on students' achievement in Mathematics is significant. This main effect was in favor of students in the private school. Perhaps, most of the private schools in this study had a very good achievement in their pretest scores in Mathematics achievement test. As a result of this they already have a better previous knowledge of the topics they were taught in Mathematics. This is in agreement with the findings of Chubb and Moe (1990) Coleman and Hoffer (1987) and Coleman (1982) confirm that those students in private schools usually have better achievement than those students from public schools when socioeconomic status was given consideration in their study. This finding is not in line with the findings of Lubienski and Lubienski (2006) which found out that there is slight better achievement of public schools students in Matheamtics over private schools students for those who are located in the same similar geographical environment.Similarly, the students in the private schools had a better attitude than those in public schools. The findings of this study is in accord with that of Abe and Gbenro (2014) which established that there is a significant difference in the attitude of students in the private and public schools towards Mathematics in favour of students in the private schools.

4.2.3 Main Effect of Gender on Achievement and Attitude in Mathematics

The findings of this study revealed that main effect of gender on students' achievement in Mathematics is not significant. This implies that being a male or a female does not give learner advantage in terms of achievement in Mathematics. The findings of this study is in line with that of Owolabi and Etuk-Iren (2014) which revealed that gender differences have nothing to do with students achievement in mathematics in college of education. Also, the findings of this study is also in line with that of Lindberg, Hyde and Petersen (2010) who found out in a metal analysis of 242 studies between 1990 and 2007 representing the testing of 1,286, 350 and equal variance was found among male and female. In the same vein, the findings of the study revealed that main effect of gender on students' attitude to Mathematics was not significant. The findings of this study imply that male and female students have the same attitude in Mathematics. The findings of this study is in line with that of Lourdes Mata, Monteiro and Francisco (2012) that no gender effect on students attitude towards Mathematics was identified although the girls showed a continuous decline in attitudes. On the other hand, the findings of this study contradicts that of Omorogbe (2016) who established that at the junior secondary schools level, gender has influence that is significant on students attitude to Mathematics

4.2.4 Interaction Effect of Treatment and School Type on Achievement and Attitude in Mathematics

The result from the findings of this study revealed that interaction effect of treatment and school type on students' achievement in Mathematics was not significant. The matrices in Tables 4.9 and 4.10 shows that students in private school in the control and the problem solving treatment groups were having better achievement in comparison with their peer in the public schools. This could be so due to the fact that private school students in these treatment groups had a better background in Mathematics than their colleagues in public schools as indicated in the comparison of their posttest scores. On the other hand, students in public schools exposed to the interactive e-note instructional strategy had a slightly better achievement mean score than those in the private schools. The only treatment which made the public students do better than private was the interactive e-note. This implies that the achievement deficit of the public schools students in Mathematics can be bridged through an interactive e-note instructional strategy. The finding of inferred that the students attitude to Mathematics can be influenced through significant interaction effect that occurs between treatment and school type. This interaction effect was found to be profound on the attitude of private students in interactive e-note. On the other hand the students exposed to problem solving instructional strategies in public school were found to have a better attitude than their colleagues in private schools. It could be inferred that interaction e-note strategy improved the attitude of students significantly in both private and public schools. This is may be attributed to the fact that interactive e-note arouses students interest and by extension it also influences their attitude. Furthermore, the problem solving might have influenced the attitude of students in public school more than the private school because the students in public schools were easily immersed into the problem solving strategies compared to their counterparts in the private schools.

4.2.5 Interaction Effect of Treatment and gender on Achievement in and Attitude to Mathematics

The result of the finding makes it known that the interaction effect of treatment and gender on students' achievement in Mathematics is not significant. This means that the treatment worked effectively on male and as well as female students. The finding of this study corroborates the findings of Leder, (1982); Eccles and Blumenfeld, (1985) and Koehler, (1990) that there is no doubt the way teacher treated each students based on their gender has direct influence on gender differences in achievement in Mathematics. The finding of the study also agrees with that of Abonyi, Maduagwuna, Ugamma (2014) which established that interaction of teaching method and gender on junior secondary two achievement in quadratic expression was not significant. The findings of this study however deviates from the findings of Oladayo (2012) which showed that there is a significant interaction of gender and teaching methods on students achievement in Mathematics. In the same vein the result indicates that there is no interaction effect of treatment and gender that was significant on students' attitude to Mathematics. This implies that the treatment worked effectively on female and as well as the male students. This finding contradicts the findings of Kaino (2015) which indicates that girls find computer more useful in the learning of Mathematics than boys. The finding of this study is not in line with that of Igbo,Onu and Obiyo (2015) which revealed that gender has significant influence on students' achievementirrespective of the method of teaching in Mathematics.

4.2.6 Interaction Effect of School type and gender on Achievement in and Attitude to Mathematics

The findings indicated that interaction effect of school type and gender on the achievement of students in Mathematics was not significant. This implies that the type of school the students attended do not in any way affect the achievement of both male and female students in Mathematics. The result also showed that the interaction effect of school type and gender was not significant on the attitude of students towards Mathematics. The attitude of both male and female is not sensitive to the type of school they attended.

4.2.7 Interaction Effect of Treatment, School type and gender on Achievement in and Attitude to Mathematics

The findings of this study revealed that the interaction effect of treatment, school type and gender on the achievement of students in Mathematics was not significant. This implies that the type of school and the gender of students does not in any way hinders or give any advantage to the potency of the treatment on students' achievement. The treatment was effective among male and female students in private school as it is among the male and female students in public schools. The result also showed that the interaction effect of treatment, school type and gender was not significant on the attitude of students towards Mathematics. The attitude of both male and female in private schools in different treatment groups is not different from that of the male and female students in public schools in the different treatment groups

CHAPTER FIVE

SUMMARY OF FINDINGS, CONCLUSION AND RECOMMENDATIONS

This chapter presents the summary of the findings, the implications of the findings of this study for the teaching and learning of Economics as well as recommendations and conclusions.

5.1 Summary of Findings

The major findings as it relates to the main and interaction effects, in the study are highlighted below:

(a) Treatments had a significant main effect on students' achievement in Mathematics and the significant main effect is largely due to interactive e-note instructional strategy

(b) Treatments had significant main effect on students attitude towards Mathematics and the significant main effect was largely attributed to interactive e-note strategy

(c) School type had a significant main effect on students' achievement in and attitude to Mathematics

(d) Gender had no significant main effect on students' achievement in and attitude to Mathematics

(a) Treatment and school type had a significant interaction effect on students' achievement in Mathematics; this interaction effect favoured the students in private school in the problem solving group while it favoured students in public school in interactive e-note group,this might be as a result of the recent recruitment of competent mathematics teachers by the state government and effective monitoring and supervision carried out by the state ministry of education. Furthermore since students' in the public school in conventional group had access to ready prepared lesson note with the aid of prepared package for the first time, seize the opportunity to read and understand the concepts taught very well hence their better achievement.

(b) Treatment and school type had a significant interaction effect on students' attitude towards Mathematics in favour of students in private school in the interactive e-note strategy

(c) Treatment and gender had no significant interaction effect on students' achievement in and attitude to Mathematics

(d) Gender and School type had no significant interaction effect on students' achievement in and attitude to Mathematics

(e) Treatment, school type and gender had no significant interaction effect on students' achievement in and attitude to Mathematics

5.2 Conclusion

It was concluded due to findings from this study that teaching junior secondary school students' Mathematics using interactive e-note instructional strategy, their achievement would improve significantly most especially those in public schools whose achievement is not at par with those in private schools. Also it was concluded that teaching students' with problem solving and interactive e-note strategies improved students' attitude to Mathematics significantly.

5.3 Implications of the Findings

The findings of the study has the following implications to classroom practices

1. No matter the strategy employed, students in private school are better than their counterparts in terms of their attitude to Mathematics.
2. Also teaching public schools students with instructional strategies which integrate information and communication technology to teaching can bridge the achievement gaps that exists between students in public schools and their colleagues in private school
3. Also deploying instructional strategy that allows students to interacts like interactive e-note works the same way for male and female in terms of improvement of students achievement in Mathematics

5.4 Recommendations

In view of the outcome of this study the following recommendations were made

1. Teachers should adopt the interactive e-note and problem solving instructional strategies to teach students' Mathematics so as to improve their achievement and attitude to Mathematics.
2. Teachers should also be trained in information and communication technology so that they can easily deploy use of interactive e-note instructional strategy
3. There is need to adopt interactive e-note instructional strategy for the teaching of Mathematics in junior secondary school so as to improve the poor achievement of students in Mathematics

4. It is also important that teachers, parents and other stakeholder are trained and equipped with the skills of making students unlearn the gender stereotypes they have attributed to Mathematics.
5. Furthermore government should create a conducive learning environment in schools by establishing computer laboratories and train teachers in the development of mathematical problem solving kits which would ensure that instructional strategies like interactive e-note and problem solving could be easily implemented in schools
6. Private school owners should also focus on how to make available computer laboratories to make the learning of Mathematics conducive so as to facilitate interactive e-note instructional strategy

5.5 Contribution to Knowledge

This study established that teaching junior secondary school students Mathematics using problem solving and interactive e-note strategies improves students' achievement in and attitude to Mathematics. Also, this study has proved the potency of interactive e- note instructional strategy to bridge students' achievement in Mathematics.

5.6 Limitation to the study

1. The findings of the study excluded the impact of the treatment on other dependent measures such as confidence to solve Mathematics problem
2. Other mathematical topics apart from algebra and number and numeration were not taught
3. Only a class in the junior secondary school was used for this study
4. There are many other variables that could moderate the effect of treatment on students' achievement and attitude to Mathematics which this study did not put into consideration

5.7 Suggestion for further Study

1. This study should be replicated with emphasis on the impact of treatment on other dependent measures like interest and mathematical confidence to solve problems
2. The efficacy of the interactive e-note and problem solving instructional strategies on other topics in Mathematics should be determined
3. The study should be replicated both at the senior secondary and primary schools.
4. In subsequent studies the moderating effect of other variables apart from gender and school type on the achievements and attitude to Mathematics should be examined.

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APPENDIX 1

MATHEMATICS ACHIEVEMENT TEST (MAT)

This questionnaire was design solely for research purpose. Your response(s) will be treated with confidentiality it deserves.

Thank you.

Section A: Demographic Data

1. Students Name:
2. Sex: Male ☐ Female ☐
3. Name of school:……………………………………………………………………………
4. School type: Private ☐ Public ☐
5. Class:

Section B: Please underline the appropriate option to the following questions from letter A to D

1. Round up 9.6478 to nearest thousandth

   A. 9.60078 B. 9.6500 C. 9.6470 D. 9.6488
2. Convert 68 to binary number

   A. 1000100_{two} B. 1000101_{two} C. 1000111_{two} D. 1000110_{two}
3. Calculate 110_{two} x $(1011_{two} + 1001_{two} – 101_{two})$

   1. 1111011_{two} B. 1011101_{two} C. 1101101_{two} D. 1011010_{two}
4. What is the place value of 3 in this number 238.614?

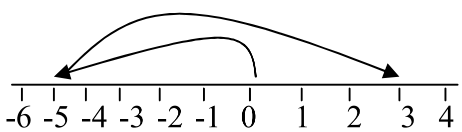
   A. Thousand B. Ten C. Hundred D. unit
5. Find the actual calculation of 53-38

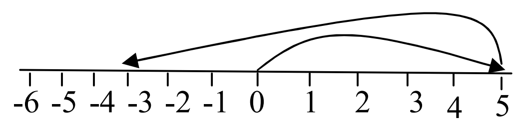
   A. 12 B. 16 C. 5 D. 15
6. Evaluate (+14)- (-20)

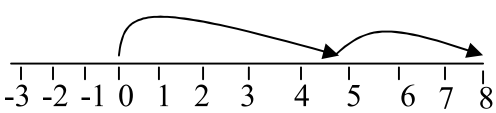
   A. 34 B. 48 C. 19 D. 52
7. Arrange in descending order +8, -82, -7, 0, +3

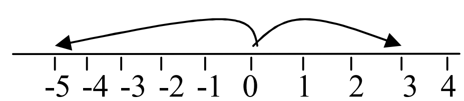
   A. 0, 3, -7 , 8 ,-82 B. -82, -7, 3, 0, 8 C. 8, 3, 0, -7, -82 D. -7, 8, 3, -82, 0
8. Fine the value of 5+ ☐ + 2 + △ if 8 goes into each shape A. 14 B. 36 C. 45 D. 23

9. Estimate 0.00092 – 0.00057 A. 0.00064 B. 0.00030 C.0.00045 D. 0.00071
10. Round up 20.6545 to two decimal places A. 20.65 B. 20.76 C. 20.66 D. 21. 00
11. What value will make this statement true 3 △ = 21 A. 5 B. 19 C. 12 D 7
12. Find the unknown term in this expression 2(x+1) = 8 A. X= 9 B. X=12 C. X=3 D. X=16
13. Simplify $\frac{X+2}{6}$ - $\frac{2X}{3}$ A. $\frac{X-3}{6}$ B. $\frac{2-3X}{6}$ C. $\frac{3-X}{6}$ D. $\frac{X+3}{6}$
14. Seven is subtracted from a number, the result is 9. Find the number A. 20 B. 28 C. 43 D. 16
15. Find the value of the letter M in 13+M = 30 A. 4 B. 17 C. 11 D. 19
16. Evaluate using number line (-5) + 8

A. 

B. 

C. 

D. 

17. A packet of sweet has a mass of 185g. If there are 26 sweets in the packet, estimate the mass of a sweet to 1 significant figure A. 7g B. 12g C. 23g D. 30g
18. Convert 10101_{two} to base ten. A. 12 B. 24 C. 17 D. 31
19. Find the value of $(1000_{two})^2$ leaving your answer in base 2. A. 1100010_{two} B. 1000000_{two} C. 1010101_{two} D. 1110110_{two}
20. ₦ 30 is to be shared equally among 6 boys. If one of the boys spent 76 kobo out of his own share. How much does he have left in kobo? A. 120k B. 316k C. 424k D. 228k.
21. Estimate 70÷35 A. 4 B. 2 C. 5 D. 3
22. Approximate 15.2 x 1.7 to the nearest whole number A. 26 B. 48 C. 52 D. 30
23. Binary numbers are made up of ______ and _______ digits. A. 0 and 1 B. 0 and 2 C. 1 and 2 D. 0, 1 and 2
24. Which of this is true? A. 8 ≥ 4 B. 2 ≥ 5 C. -3 < -5 D. 7>3
25. Evaluate +10 + (-6) A. 0 B. 6 C. 4 D. 12
26. If every shape has an equal number, find the number in each shape. △ = 14- □

A. 7 B. 9 C. 10 D. 3

27. Round up 5538g to the nearest 100g A. 5140g B. 5610g C. 5500g D. 5400g

28. Estimate 43+62+59 A. 160 B. 100 C. 130 D. 98

29. If $\frac{2y}{4}$ = 5, find the value of y A. 12 B. 8 C. 16 D. 10

30. Am thinking of a number of which twice the number equals 12, find the number

A. 10 B. 6 C. 4 D. 8

APPENDIX II

STUDENTS ATTITUDE TOWADRS MATHEMATICS QUESTIONNAIRE (SATMQ)

The following questions refer to the way you feel about learning Mathematics. Please tick the most appropriate option to you from SA (Strongly Agree), A (Agree), D (Disagree), SD (Strongly Disagree).

Thank you.

1.	I am sure that I can learn Mathematics.	SA	A	D	SD
2.	I struggled with many concepts in Mathematics.	SA	A	D	SD
3.	Knowing Mathematics will help me earn a living.	SA	A	D	SD
4.	I don't think I could do advanced Mathematics.	SA	A	D	SD
5.	I don't want to teach Mathematics in future	SA	A	D	SD
6.	I have often helped others with their Mathematics home work.	SA	A	D	SD
7.	I did not like being introduced to new mathematical content.	SA	A	D	SD
8.	Mathematics is hard for me.	SA	A	D	SD
9.	I usually comprehend Mathematics content and seldom get lost	SA	A	D	SD
10.	I'll need Mathematics for my future work.	SA	A	D	SD
11.	Mathematics makes me feel uncomfortable and nervous	SA	A	D	SD
12.	I am making progress in understanding Mathematics.	SA	A	D	SD
13.	I don't expect to use much Mathematics when I get out of school.	SA	A	D	SD
14.	My Mathematics teachers were supportive in my efforts to learn Mathematics.	SA	A	D	SD
15.	I have usually been at ease during Mathematics test.	SA	A	D	SD
16.	I get really uptight during Mathematics test	SA	A	D	SD
17.	My teacher had confidence in me as a student of Mathematics.	SA	A	D	SD
18.	I learn best when my teacher took time to connect new concepts to my	SA	A	D	SD

previous knowledge

19. I'm not the type to do well in Mathematics. SA A D SD

20. I have taken Mathematics classes even though they were not required. SA A D SD

21. I have dropped Mathematics courses because they become too difficult SA A D SD

22. I usually don't worry about my ability to solve mathematical problems SA A D SD

23. I think I could handle more difficult Mathematics SA A D SD

24. New Mathematics content has usually been easy for me to understand SA A D SD

25. I can't recall many Mathematics concepts that were hard for me to understand SA A D SD

26. When I had trouble with a concept I usually gave up and stopped trying SA A D SD

27. I get a sinking feeling when I think of trying hard Mathematics problems SA A D SD

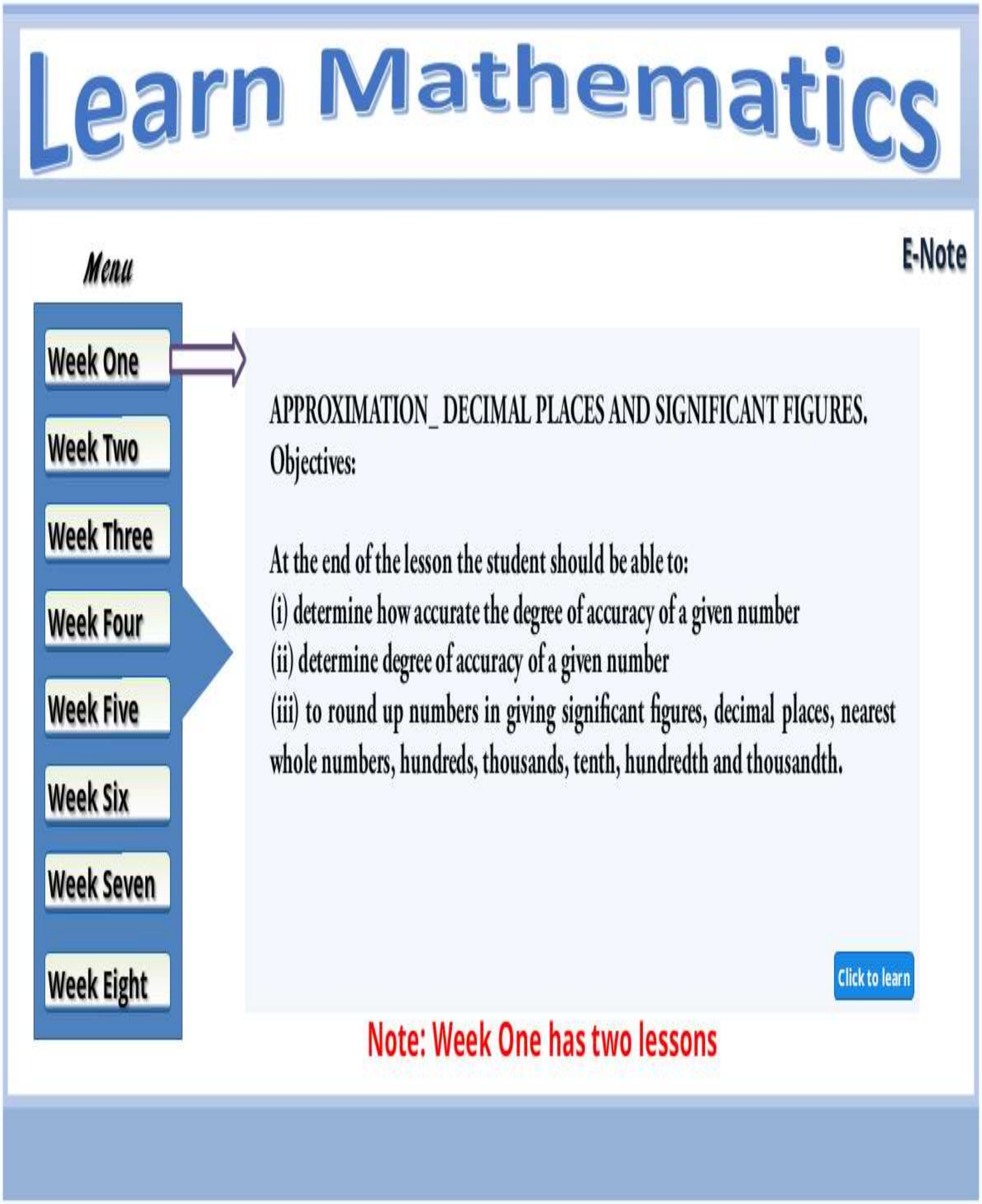
28. When confronted with a difficult Mathematics concepts, I generally worked until I understood the concept SA A D SD

29. I was frequently lost and had trouble keeping up in my Mathematics class SA A D SD

30. My mind goes blank and I am unable to think clearly when doing Mathematics. SA A D SD

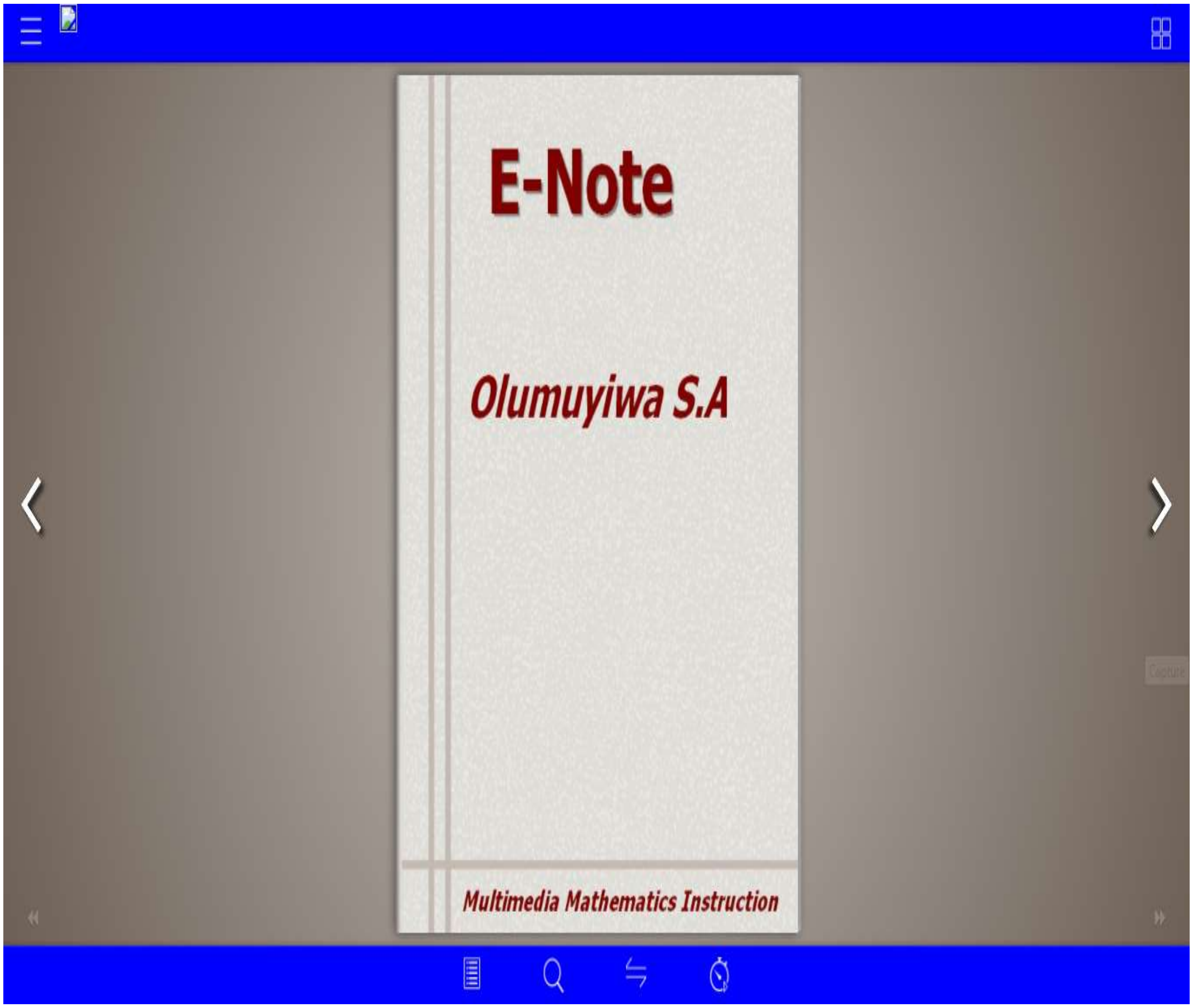
APPENDIX III a

INTERACTIVE E-NOTE MATIMATICS INSTRUCTIONAL STRATEGY (IMIS)



APPENDIX III b

INTERACTIVE E-NOTE MATIMATICS INSTRUCTIONAL STRATEGY (IMIS)



APPENDIX IV

INSTRUCTIONAL GUIDE FOR PROBLEM SOLVING STRATEGY (IGPSS)

Subject: Mathematics

Class: J.S.S 1

About the package

This is a problem solving instructional package designed to teach Mathematics in junior secondary school class one. It is a text assisted linear self- instructional programme. There are 17 lessons consisting of 3 – 5 frames per lesson in the package. The lessons are designed for 8 weeks, of which 7 weeks has two periods each while week 8 ends with a period.

Each frame poses a question and the answer is given on the indicated page. The teacher will assist in the use of the package and a student who is in doubt is free to ask for the teacher assistance. Each lesson (frames) can be completed within the normal class period assigned for it in the package.

To the teacher

The package is designed to teach the students act of problem solving in Mathematics. It is not a test and the students should be reassured of this fact. You are to guide the students to strictly adhere to the instructions in the package. It is recommended that the students write down the answer to each item on a separate sheet. They should do this before they turn over to the indicated page to compare their answer. Please check that all students understand how to work through the package before they begin. Also ensure that each student work independently when using the package.

General objectives

By the time lesson comes to an end, individual students should be able, own their own, to:

(i) determine the degree of accuracy of a given number

(ii) round up numbers to given significant figures, decimal places, nearest Whole number, tens, hundred, thousand, tenth, hundredth and thousandth.

(iii) solve problems on approximation

(iv) solve problems involving number in base two.

(v) add and subtract numbers with emphasis on place value and using the number line

(vi) add and subtract integers

(vii) use symbols in open sentences to carry out arithmetic operations

(viii) translate word problems in mathematical expressions to an open sentences and solve same

(ix) solve basic operations in algebraic process

To the students

This learning package is specially designed to teach you the application of problem solving strategy to Mathematics. Do not write anything on this book. Each page asks you a question; please write down your answer on a separate sheet before turning over to the answer on the indicated page and the next item. Remember to follow these steps:

(i) After reading through a page (frame), write down your answer on a separate sheet of paper

(ii) Check the answer to a frame before reading the next question and after you have written your own answer.

(iii) Return the package to your teacher after each lesson.

The package is not a test so read the questions carefully before attempting the answer

Required materials

Mathematics notebook(s), writing materials, ruler and pencil

An 8 week Problem Solving Package for J.S.S 1students

Week	Contents
Week 1	
Period 1	Approximation
Period 2	Rounding up of numbers and significant figures
Week 2	
Period 1	Approximation in everyday activities
Period 2	Number bases
Week 3	
Period 1	Operations with binary numbers
Period 2	Basic operations
Week 4	
Period 1	Place value
Period 2	Integers

Week 5

Period 1 Ordering of numbers

Period 2 Algebraic process

Week 6

Period 1 Use of letters in open sentences

Period 2 Word problems

Week 7

Period 1 Algebraic operations on terms involving symbols

Period 2 Simple equations with one variable and the use of equality sign

Week 8

Period 1 Translating word sentences into simple equations.

APPENDIX IV

INSTRUCTIONAL GUIDE FOR PROBLEM SOLVING STRATEGY (IGPSS)

1

Lesson 1(Week 1): APPROXIMATION FRAME 1-5

Sub topic DECIMAL PLACES AND SIGNIFICANT FIGURES.

Objectives: By the time lesson comes to an end, individual students should be able, own their own, to:

i. determine how accurate the degree of accuracy of a given number

ii. determine degree of accuracy of a given number.

Class Jss1

Duration 40 minutes

Step 1. Conceive a problem : Approximation

Step 2. Devise a plan: Students read through frame 1

2

Answer to frame 69	Meaning and types of Approximation FRAME 1
$7 \times x - 5 = 16$ $7x - 5 = 16$ Add 5 to both sides $7x - 5 + 5 = 16 + 5$ $7x = 21$ Divide both sides by 7 $\frac{7x}{7} = \frac{21}{7}$ $x = 3$ Step 4.: Students look back to frame 69	Approximation simply means obtaining the degree of accuracy of numbers. Types of Approximation are (a) Decimal places (b) Significant figures (a) Decimal places: This simply states the numbers of digits after the decimal. **Example** (i) 0.4 has one decimal place (ii) 0.72 has two decimal places Question: 0.056= ? decimal places Step 3. Implement the plan (Students write down the answer to the question before checking the correct answer in page 4) Answer: Go to page 4

Step 1. Conceive a problem : Approximation

Step 2. Devise a plan :Students read through frame 2

3

Answer to frame 70	FRAME 2
Let x represent the girls Total no of girls = x + 46 Let y represent total no of boys Y + x + 46 = 360 If y = x Then 2y = 360 – 46 Y = 314/2 Y = 157 Step 4.: Students look back to frame 70	Question: Estimate 31 + 63 Step 3. Implement the plan (Students write down the answer to the question before checking the correct answer in page 5) Answer: Go to page 5

Step 1. Conceive a problem : Approximation

Step 2. Devise a plan: Students read through frame 3

4

Answer to frame 1	FRAME 3
Three decimal places Step 4.: Students look back to frame 1	Question: Estimate 67 – 36 Step 3. Implement the plan (Students write down the answer to the question before checking the correct answer in page 6) Answer: Go to page 6

Step 1. Conceive a problem : Approximation

Step 2. Devise a plan :Students read through frame 4

5

Answer to frame 2	FRAME 4
31 + 63 = 94 – Actual Calculation	

Approximation is 30 + 60 = 90 Step 4.: Students look back to frame 2	Question: Estimate 7.2 x 9.8 Step 3. Implement the plan (Students write down the answer to the question before checking the correct answer in page 8) Answer: Go to page 8

Step 1. Conceive a problem : Approximation

Step 2. Devise a plan :Students read through frame 5

6

Answer to frame 3	FRAME 5
67 - 36 = 31 – Actual Calculation Approximation is 70 - 40 = 30 Step 4.: Students look back to frame 3	Question: Estimate 46÷ 23 Step 3. Implement the plan (Students write down the answer to the question before checking the correct answer in page 9) Answer: Go to page 9

APPENDIX IV

INSTRUCTIONAL GUIDE FOR PROBLEM SOLVING STRATEGY (IGPSS)

Week1(Lesson 2): ROUNDING UP OF NUMBERS AND SIGNIFICANT FIGURES

FRAME 6- 10

Sub topic DECIMAL PLACES AND SIGNIFICANT FIGURES.

Objectives: By the time lesson comes to an end, individual students should be able, own their own, to round up numbers in giving significant figures, decimal places, nearest whole numbers, hundreds, thousands, tenth, hundredth and thousandth.

Class Jss1

Duration 40 minutes

Step 1. Conceive a problem : Rounding up of numbers and significant figures

Step 2. Devise a plan :Students read through frame 6

8

Answer to frame 4	Meaning of rounding up FRAME 6
7.2 X 9.8 7. 2 X 9. 8 576 648 70.56 Approximation is 7.0 x 10 = 70 Step 4.: Students look back to frame 4	Answer to mathematical question can be approximated to a whole number, significant figures or decimal places. A number from 0 to 4 are rounded down as zero while a number from 5 to 9 are rounded up as one Question: Convert the following into 1 decimal place (a) 0.00159 (b) 8.6456 (c) 19.6545 Step 3. Implement the plan (Students write down the answer to the question before checking the correct answer in page 10) Answer: Go to page 10

Step 1. Conceive a problem : Rounding up of numbers and significant figures

Step 2. Devise a plan :Students read through frame 7

9

Answer to frame 5	FRAME 7
46 ÷ 23= 2 46 23 | 46 00 Approximation is 50 ÷ 20= 2 Step 4.: Students look back to frame 5	Question: Convert (i) 0.00159 (ii) 8.6456 (iii) 19.6545 (a) 2 decimal places (b) 3 decimal places Step 3. Implement the plan (Students write down the answer to the question before checking the correct answer in page 11) Answer: Go to page 11

Step 1. Conceive a problem : Rounding up of numbers and significant figures

Step 2. Devise a plan: Students read through frame 8

10

Answer to frame 6	FRAME 8
(i) 0.00159 = 0.0 (ii) 8.6456 = 8.6 (iii) 19.6545 = 19.7 Step 4.: Students look back to frame 6	Question: Round up 415,762 correct to the nearest (a) ten (b) hundred (c) thousand (d) ten thousand Step 3. Implement the plan (Students write down the answer to the question before checking the correct answer in page 12) Answer: Go to page 12

Step 1. Conceive a problem : Rounding up of numbers and significant figures

Step 2. Devise a plan :Students read through frame 9

11

Answer to frame 7	FRAME 9

(a) To 2 decimal places (i) 0.00159 = 0.00 (ii) 8.6456 = 8.65 (iii) 19.6545 = 19.65 (b) To 3 decimal places (i) 0.00159 = 0.002 (ii) 8.6456 = 8.646 (iii) 19.6545 = 19.655 Step 4.: Students look back to frame 7	Question: Round up 0.79874 correct to the nearest (a) tenth (b) hundredth (c) thousandth (d) whole number Step 3. Implement the plan (Students write down the answer to the question before checking the correct answer in page 14) Answer: Go to page 14

Step 1. Conceive a problem : Rounding up of numbers and significant figures

Step 2. Devise a plan :Students read through frame 10

12

Answer to frame 8	FRAME 10
(a) 415,762 = 415,760 to the nearest ten (b) 415,762 = 415,800 to the nearest hundred (c) 415,762 = 416,000 to the nearest thousand (d) 415,762 = 420, 000 to the nearest ten thousand. Step 4.: Students look back to frame 8	Question: Round up (a) 713 (b) 0.275 to one significant figure Step 3. Implement the plan (Students write down the answer to the question before checking the correct answer in page 14) Answer: Go to page 15

APPENDIX IV

INSTRUCTIONAL GUIDE FOR PROBLEM SOLVING STRATEGY (IGPSS)

13

Lesson 1(Week 2): APPROXIMATION IN EVERYDAY ACTIVITIES FRAME 11 - 15

Sub topic ROUNDING UP OF NUMBERS

Objectives: By the time lesson comes to an end, individual students should be able, own their own, to:

i. determine the degree of accuracy of numbers.

ii. Solve problems on rounding up of numbers.

Class Jss1

Duration 40 minutes

Step 1. Conceive a problem : Approximation on everyday activities

Step 2. Devise a plan :Students read through frame 11

14

Answer to frame 9	FRAME 11
(a) 0.79874 = 0.8 to the nearest tenth (b) 0.79874 = 0.80 to the nearest hundredth (c) 0.79874 = 0.799 to the nearest thousandth (d) 0.79874 = 1.0 to the nearest whole number Step 4.: Students look back to frame 9	Question: Round up (a) 175kg to the nearest 10 kg (b) 5538g to the nearest 100 g (c) 62435 tones to the nearest 1000 tones Step 3. Implement the plan (Students write down the answer to the question before checking the correct answer in page 16) Answer: Go to page 16

Step 1. Conceive a problem : Approximation on everyday activities

Step 2. Devise a plan :Students read through frame 12

15

Answer to frame 10	FRAME 12
(a) 713 = 700 to one significant figure (b) 0.275 = 0.3 to one significant figure Step 4.: Students look back to frame 10	Question: Round up the following to the nearest cm (a) 23.7 cm (b) 6.5 cm (c) 8.1 cm Step 3. Implement the plan (Students write down the answer to the question before checking the correct

	answer in page 17) Answer: Go to page 17

Step 1. Conceive a problem : Approximation on everyday activities

Step 2. Devise a plan :Students read through frame 13

16

Answer to frame 11	FRAME 13
(a) 175kg = 180 kg to the nearest 10 kg (b) 5538g = 550g to the nearest 100 g (c) 62435 = 62, 000 tones to the nearest 1000 tones Step 4.: Students look back to frame 11	Question: A packet of sweets has a mass of 185g. if there are 26 sweets in the packets, estimate the mass of a sweet to 1 significant figure Step 3. Implement the plan (Students write down the answer to the question before checking the correct answer in page 18) Answer: Go to page 18

Step 1. Conceive a problem : Approximation on everyday activities

Step 2. Devise a plan :Students read through frame 14

17

Answer to frame 12	FRAME 14
(a) 23.7cm = 24cm (b) 6.5cm = 7cm (c) 8.1cm = 8cm Step 4.: Students look back to frame 12	Question: If one tuber of yam cost ₦1.85k, estimate the cost of 17 tubers. Step 3. Implement the plan (Students write down the answer to the question before checking the correct answer in page 20) Answer: Go to page 20

Step 1. Conceive a problem : Approximation on everyday activities

Step 2. Devise a plan :Students read through frame 15

18

Answer to frame 13	FRAME 15

185g÷26= 7 $26\overline{)185}$ $\underline{182}$ 3 ∴ The mass of a sweet is 7g to 1 significant figure. Step 4.: Students look back to frame 13	Question: Round up (a) 73.2kg (b) 8.67kg (c) 15.7kg to the nearest kg Step 3. Implement the plan (Students write down the answer to the question before checking the correct answer in page 21) Answer: Go to page 21

APPENDIX IV

INSTRUCTIONAL GUIDE FOR PROBLEM SOLVING STRATEGY (IGPSS)

19

Lesson 2(Week 2): NUMBER BASE **FRAME 16- 20**

Sub topic CONVERSION OF NUMBER FROM BASE TEN TO BASE TWO AND BASE TWO TO BASE TEN

Objectives: By the time lesson comes to an end, individual students should be able, own their own, to:

(i) Convert numbers from base ten to base two

ii) Convert numbers from base two to base ten.

Class Jss1

Duration 40 minutes

Step 1. Conceive a problem : Number Base

Step 2. Devise a plan :Students read through frame 16

20

Answer to frame 14	FRAME 16
1 tuber of yam cost ₦1.85k 17 tubers of yam will cost ₦1.85k x 17 = 1.8 5 X 1 7 1295 185 ₦31. 45 ₦ 31.45 is approximately ₦ 31. Step 4.: Students look back to frame 14	Counting in base two: Base two numbers or binary number is made up of only two digits: 0 and 1while denary numbers (base 10) have ten digits: 0, 1, 2, 3, 4, 5, 6, 7, 8, and 9. Question: Which of these numbers is a binary number? 0 1 2 3 4 5 6 7 8 9 Step 3. Implement the plan (Students write down the answer to the question before checking the correct answer in page 22) Answer: Go to page 22

Step 1. Conceive a problem : Number Base

Step 2. Devise a plan :Students read through frame 17

21

Answer to frame 15	FRAME 17
To the nearest kg (a) 73.2kg = 70kg (b) 8.67kg = 9kg (c) 15.7kg = 20kg Step 4.: Students look back to frame 15	Question: Convert the following base ten numbers to binary number (a) 26 (b) 39 Step 3. Implement the plan (Students write down the answer to the question before checking the correct answer in page 23) Answer: Go to page 23

Step 1. Conceive a problem : Number Base

Step 2. Devise a plan :Students read through frame 18

22

Answer to frame 16	FRAME 18
0 and 1 Step 4.: Students look back to frame 16	Question: Convert the following binary numbers to base ten numbers (a)1101 (b) 10000 Step 3. Implement the plan (Students write down the answer to the question before checking the correct answer in page 24) Answer: Go to page 24

Step 1. Conceive a problem : Number Base

Step 2. Devise a plan :Students read through frame 19

23

Answer to frame 17	FRAME 19
See the answer below frame 19. Step 4.: Students look back to frame 17	Question: Find the value of the following leaving your answer in base two $(110_{two})^2$ Step 3. Implement the plan (Students write down the answer to the question before checking the correct answer in page 26) Answer: Go to page 26

(a)

2 | 26
2 | 13 r 0
2 | 6 r 1
2 | 3 r 0
  | 1 r 1

$26 = 11010_{two}$

(b)

2 | 39
2 | 19 r 1
2 | 9 r 1
2 | 4 r 1
2 | 2 r 0
2 | 1 r 0

$39 = 100111_{two}$

Step 1. Conceive a problem : Number Base

Step 2. Devise a plan: Students read through frame 20

24

Answer to frame 18	FRAME 20
(a) $1101_2 = 1 \times 2^3 + 1 \times 2^2 + 0 \times 2^1 + 1 \times 2^0 = 8 + 4 + 0 + 1$ $= 13$ (b) $10000_2 = 1 \times 2^4 + 0 \times 2^3 + 0 \times 2^2 + 0 \times 2^1 + 0 \times 2^0 = 16 + 0 + 0 + 0 + 0$ $= 16$ Step 4.: Students look back to frame 18	Question: Convert 111000 in binary to base ten. Step 3. Implement the plan (Students write down the answer to the question before checking the correct answer in page 27) Answer: Go to page 27

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25

Lesson 1(Week 3): OPERATIONS WITH BINARY NUMBERS FRAME 21-24

Sub topic BASIC OPERATIONS IN BASE TWO

Objectives: By the time lesson comes to an end, individual students should be able, own their own, to:

i Count, add, subtract and multiply numbers in base two.

Class Jss1

Duration 40 minutes

Step 1. Conceive a problem : Operations with binary numbers

Step 2. Devise a plan :Students read through frame 21

26

Answer to frame 19	Addition of number in base two FRAME 21
$110_{two} = 1 \times 2^2 + 1 \times 2^1 + 0 \times 2^0$ $= 4 + 2 + 0 \quad = 6$ $(110_{two})^2 = (6_{ten})^2 = 3$ Convert to base 2	Question: Calculate (a) 111 <u>+ 1</u> (b) 101 <u>+ 101</u> in base two Step 3. Implement the plan (Students write down the answer to the question before checking the correct

2 | 36 2 | 18 r 0 2 | 9 r 0 2 | 4 r 1 2 | 2 r 0 1 r 0 36 = 100100_2 Step 4.: Students look back to frame 19	answer in page 27) Answer: Go to page 28

Step 1. Conceive a problem : Operations with binary numbers

Step 2. Devise a plan :Students read through frame 22

27

Answer to frame 20	Subtraction in base two FRAME 22
$111000_2 = 1x2^5 + 1x2^4 + 1x2^3 + 0x2^2$ $+0x2^1 + 0x2 + 0x2^0$ $= 32 + 16 + 8 + 0 + 0 + 0$ $=56$ Step 4.: Students look back to frame 20	Question: Calculate 1110 – 1101 in base two Step 3. Implement the plan (Students write down the answer to the question before checking the correct answer in page 29) Answer: Go to page 29

Step 1. Conceive a problem : Operations with binary numbers

Step 2. Devise a plan :Students read through frame 23

Answer to frame 21	Multiplication in base two FRAME 23
(a) 111 (b) 101 + 1 +101 1000 1010 Step 4.: Students look back to frame 21	Question: Calculate (a) 11101 x 111 (b) 1110 x1110 Step 3. Implement the plan (Students write down the answer to the question before checking the correct answer in page30) Answer: Go to page 30

Step 1. Conceive a problem : Operations with binary numbers

Step 2. Devise a plan :Students read through frame 24

29

Answer to frame 22	FRAME 24
1110 - 1101 1 Step 4.: Students look back to frame 22	Question: Calculate 110_{two} x $(1001_{two} - 101_{two})$ Step 3. Implement the plan (Students write down the answer to the question before checking the correct answer in page32) Answer: Go to page 32

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30

Lesson 2(Week 3): BASIC ARITHEMETICAL OPERATIONS FRAME 25 - 29

Sub topic ADDITION AND SUBTRACTION OF NUMBERS USING AN ABACUS

Objectives: By the time lesson comes to an end, individual students should be able, own their own, to:

i. Add, and subtract using an ABACUS.

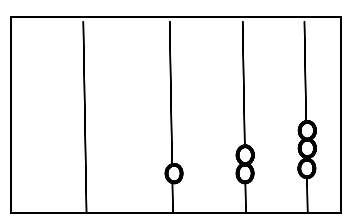
Class Jss1

Duration 40 minutes

Step 1. Conceive a problem : Basic arithmetic operations

Step 2. Devise a plan: Students read through frame 25

31

Answer to frame 23	**Counting Device: The Abacus** FRAME 25
(a) 11101 (b)111 x 111 x 110 11101 0000 11101 1110 11101 1110 11001011 1010100 Step 4.: Students look back to frame 23	Abacus is probably the first counting device, it have wires or rods on which counters could freely move back and forth. Each wire corresponds to a digit in a positional number system commonly in base 10 Example  Question: The first counting device is called what? Step 3. Implement the plan (Students write down the

	answer to the question before checking the correct answer in page33) Answer: Go to page 33

Step 1. Conceive a problem : Basic arithmetic operations

Step 2. Devise a plan: Students read through frame 26

32

Answer to frame 24	FRAME 26
110_2 x (1001_{two} – 101_{two}) = 1001 - 101 100_{two} 110_{ywo} x 100_{twu} = 110 X 100 0 0 0 0 0 0 1 1 0 1 1 0 0 0_{two} Step 4.: Students look back to frame 24	Question: Use an Abacus to represent (a) 78 (b)1982 Step 3. Implement the plan (Students write down the answer to the question before checking the correct answer in page34) Answer: Go to page 3

Step 1. Conceive a problem : Basic arithmetic operations

Step 2. Devise a plan: Students read through frame 27

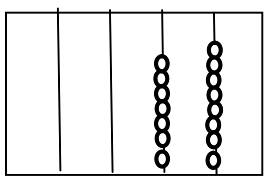
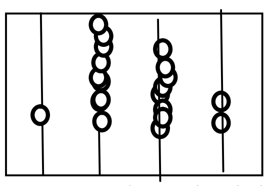
33

Answer to frame 25	Addition with Abacus FRAME 27
Abacus Step 4.: Students look back to frame 25	Question: Use an Abacus to add 102 + 54 + 343 Step 3. Implement the plan (Students write down the answer to the question before checking the correct answer in page35) Answer: Go to page 35

Step 1. Conceive a problem : Basic arithmetic operations

Step 2. Devise a plan :Students read through frame 28

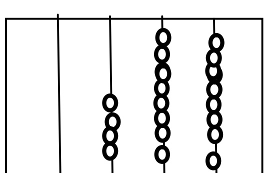
34

Answer to frame 26	Subtraction with Abacus FRAME 28
a)  (b)  Step 4.: Students look back to frame 26	Question: Represent 894 – 544 on an abacus Step 3. Implement the plan (Students write down the answer to the question before checking the correct answer in page37) Answer: Go to page 37

Step 1. Conceive a problem : Basic arithmetic operations

Step 2. Devise a plan :Students read through frame 29

35

Answer to frame 27	FRAME 29
102 + 54 + 343 = 499  Step 4.: Students look back to frame 27	Question: An Abacus consists of ………and …….. Step 3. Implement the plan (Students write down the answer to the question before checking the correct answer in page38) Answer: Go to page 38

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Lesson 1(Week 4): PLACE VALUE FRAME 30 - 34

Sub topic ADDITION, SUBTRACTION AND PLACE VALUE

Objectives: By the time lesson comes to an end, individual students should be able, own their own, to:

i Add and subtract numbers with emphasis on place values.

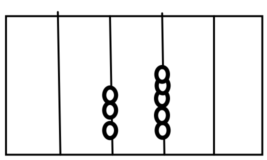
Class Jss1

Duration 40 minutes

Step 1. Conceive a problem Addition, subtraction and place value

Step 2. Devise a plan :Students read through frame 30

37

Answer to frame 28	FRAME 30
894 - 544 = 350  Step 4.: Students look back to frame 28	The Hindu-Arabic number system [0 1 2 3 4 5 6 7 8 9] has the place value number different from previous number systems **Digit** **System** **Symbol** 1 Unit U 10 Ten T 100 Hundred H 1,000 Thousand TH 10,000 Ten Thousand TTH 100,000 Hundred Thousand HTH 1,000,000 Million M Question: List the digits contained in Hindu Arabic system Step 3. Implement the plan (Students write down the answer to the question before checking the correct answer in page39) Answer: Go to page 39

Step 1. Conceive a problem Addition, subtraction and place value

Step 2. Devise a plan :Students read through frame 31

38

Answer to frame 29	FRAME 31
Wire or rod and counters Step 4.: Students look back to frame 29	Question: Write down the place value of (a) 406 (b) 6024 Step 3. Implement the plan (Students write down the answer to the question before checking the correct answer in page 40) Answer: Go to page 40

Step 1. Conceive a problem Addition, subtraction and place value

Step 2. Devise a plan :Students read through frame 32

39

Answer to frame 30	FRAME 32
0 1 2 3 4 5 6 7 8 9 Step 4.: Students look back to frame 30	Question: Write down the place value of (a) 21.05 (b) 621.01 (c) 0.1265 Step 3. Implement the plan (Students write down the answer to the question before checking the correct answer in page 41) Answer: Go to page 41

Step 1. Conceive a problem Addition, subtraction and place value

Step 2. Devise a plan :Students read through frame 33

40

Answer to frame 31	FRAME 33
See answer below frame 33 Step 4.: Students look back to frame 31	Question: Write down the place value of 238.614 Step 3. Implement the plan (Students write down the answer to the question before checking the correct answer in page 43) Answer: Go to page 43

(a) 4 0 6

hundred ten unit

(b) 6 0 2 4

thousand hundred ten unit

Step 1. Conceive a problem Addition, subtraction and place value

Step 2. Devise a plan :Students read through frame 34

41

Answer to frame 32	FRAME 34
See answer below frame 34 Step 4.: Students look back to frame 32	Question: What is the place value of (a) 3 in 6.302 (b) 5 in 0.053 Step 3. Implement the plan (Students write down the answer to the question before checking the correct answer in page 44) Answer: Go to page 44

(a) 2 . 1 0 5

unit, decimal point, tenth, hundredth, thousandth

(b) 6 2 1 . 0 1

hundred, tens, unit, decimal point, tenth, hundredth

(c) 0 . 1 2 6 5

tenth, hundredth, thousandth, ten thousandth

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Lesson 2(Week 4): INTEGERS FRAME 35 - 39

Sub topic ADDITION AND SUBTRACTION OF POSITIVE AND NEGATIVE INTEGERS

Objectives: By the time lesson comes to an end, individual students should be able, own their own, to:

i Add, subtract positive and negative integers.

Class Jss1

Duration 40 minutes

Step 1. Conceive a problem Addition, subtraction of positive and negative integers

Step 2. Devise a plan :Students read through frame 35

`

43

Answer to frame 33	FRAME 35
See answer below frame 35 Step 4.: Students look back to frame 33	Integers are numbers positive or negative $\pm 1 \ \pm 2 \ \pm 3 \ \pm 4$ etc Question: What is the general name for these numbers -2 -1 1 2 3? Step 3. Implement the plan (Students write down the answer to the question before checking the correct answer in page 45) Answer: Go to page 45

2 3 8 . 6 1 4

ten hundredth

hundred **unit** **tenth** thousandth

Step 1. Conceive a problem Addition, subtraction of positive and negative integers

Step 2. Devise a plan :Students read through frame 36

44

Answer to frame 34	**Addition of Directed Numbers** FRAME 36
(a) 6 . 3 0 2 ↑ Tenth (b) 0 . 0 5 3 ↓ Hundredth Step 4.: Students look back to frame 34	Note the following rules of signs + x + = + + x - = - - x - = + - x + = - Algebraic Addition is the collection together using rules of signs as stated above. Question: What is the rules that govern addition of directed numbers? Step 3. Implement the plan (Students write down the answer to the question before checking the correct answer in page 46) Answer: Go to page 46

Step 1. Conceive a problem Addition, subtraction of positive and negative integers

Step 2. Devise a plan :Students read through frame 37

45

Answer to frame 35	FRAME 37
Integers Step 4.: Students look back to frame 35	Question: Evaluate (a) (+3) + (-5) (b) (+10) + (-8) (c) (+4) + (+12) Step 3. Implement the plan (Students write down the answer to the question before checking the correct answer in page 47) Answer: Go to page 47

Step 1. Conceive a problem :Addition, subtraction of positive and negative integers

Step 2. Devise a plan: Students read through frame 38

Answer to frame 36	FRAME 38
Rules of signs Step 4.: Students look back to frame 36	Question: Evaluate (a) (+30) -(-10) (b) (-13) -(+10) (c) (-4) - (-16) Step 3. Implement the plan (Students write down the answer to the question before checking the correct answer in page 49) Answer: Go to page 49

Step 1. Conceive a problem: Addition, subtraction of positive and negative integers

Step 2. Devise a plan: Students read through frame 39

47

Answer to frame 37	FRAME 39
(a) (+3) + (-5) = + (3-5) = -2 (b) (+10) + (-8) = + (10 - 8) = +2 (c) (+4) + (+12) = + (4 + 12) = +16 Step 4.: Students look back to frame 37	Question: Evaluate (a) (+7) + (+5) (b) (-8) -(-9) Step 3. Implement the plan (Students write down the answer to the question before checking the correct answer in page 50) Answer: Go to page 50

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Lesson 1(Week 5): ORDERING OF NUMBERS FRAME 40 - 44

Sub topic USE O SYMBOLS IN OPEN SENTENCES, ACENDING AND DESCENDING ORDER, NUMBERLINE

Objectives: By the time lesson comes to an end, individual students should be able, own their own, to:

i Use symbol in open sentences in carrying out arithmetic operations

ii Arrange numbers in ascending and descending orders

iii Represent integers on number lines.

Class Jss1

Duration 40 minutes

Step 1. Conceive a problem: Addition, subtraction of positive and negative integers

Step 2. Devise a plan: Students read through frame 40

49

Answer to frame 38	FRAME 40
(a) (+30) - (-10) = + (30+10) = +40 (b) (-1) - (+10) = - 13 - 10 = -23 (c) (-4) - (-16) = -4 + 16) = +12 Step 4.: Students look back to frame 38	Numbers may be arranged in ascending order that is from smaller to larger ones or in descending order, larger to smaller ones. We need the following signs to do this: (1) $=$ equal to (2) $\neq$ not equal to (3) $\simeq$ is about equal to or nearly equal to (4) $>$ greater than (5) $\geq$ greater than or equal tpo (6) $<$ less than (7) $\leq$ less than or equal to Question: What does ordering of numbers mean? Step 3. Implement the plan (Students write down the

	answer to the question before checking the correct answer in page 51) Answer: Go to page 51

Step 1. Conceive a problem: Addition, subtraction of positive and negative integers

Step 2. Devise a plan: Students read through frame 41

50

Answer to frame 39	FRAME 41
(a) (+7) + (-5) = + (7+5) = +12 (b) (-8) -(-9) = -8 + 9 = +1 Step 4.: Students look back to frame 39	Question: |In the box provide put < or > where appropriate (a)5 $\square$ 10 (b) -5 $\square$ 10 (c) 3 $\square$ 15 Step 3. Implement the plan (Students write down the answer to the question before checking the correct answer in page 52) Answer: Go to page 52

Step 1. Conceive a problem: Addition, subtraction of positive and negative integers

Step 2. Devise a plan: Students read through frame 42

51

Answer to frame 40	FRAME 42
Arrangement of numbers in ascending or descending order Step 4.: Students look back to frame 40	Question: Arrange the following in ascending order (a) 14 , 8 , 16 (b) -8, -4, -6, -14 Step 3. Implement the plan (Students write down the answer to the question before checking the correct answer in page 53) Answer: Go to page 53

Step 1. Conceive a problem: Addition, subtraction of positive and negative integers

Step 2. Devise a plan :Students read through frame 43

52

Answer to frame 41	FRAME 43
(a)5 > - 10 (b) -5 < 10 (c) 3 < 15 Step 4.: Students look back to frame 41	Question: Evaluate the following with number line (a) (-9) – (-14) (b) 19 – (-13) (c) -8- (+7) Step 3. Implement the plan (Students write down the answer to the question before checking the correct answer in page 55) Answer: Go to page 55

Step 1. Conceive a problem: Addition, subtraction of positive and negative integers

Step 2. Devise a plan: Students read through frame 44

53

Answer to frame 42	FRAME 44
(a) 14 , 8 , 16 = 8, 14, 16 (b) -8, -4, -6, -14= -14, -8, -6, -4 Step 4.: Students look back to frame 42	Question: Oluade moved 14 paces to the north, then moved 20 paces to the south. What is his final position? Step 3. Implement the plan (Students write down the answer to the question before checking the correct answer in page 56) Answer: Go to page 56

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Lesson 2(Week 5): ALGEBRAIC PROCESSES FRAME 45- 49

Sub topic USE O SYMBOLS IN OPEN SENTENCES AND IDENTIFICATION OF COEFFICIENTS .

Objectives: By the time lesson comes to an end, individual students should be able, own their own, to:

(i) Use symbol in open sentences in carrying out arithmetic operations

(ii) Identify coefficients of terms of a given algebraic expressions.

Class Jss1

Duration 40 minutes

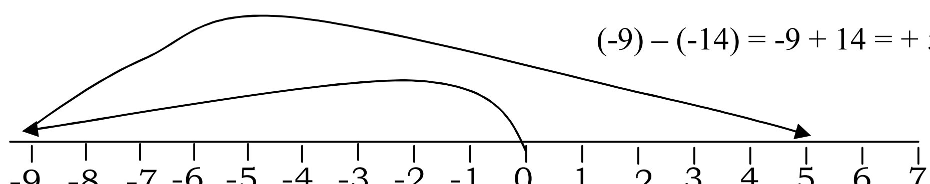
Step 1. Conceive a problem use of symbols in open sentences and identification of coefficients

Step 2. Devise a plan: Students read through frame 45

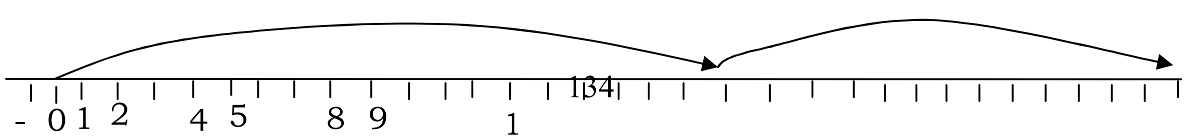
55

Answer to frame 43	FRAME 45
See the diagrams below frame 45 Step 4.: Students look back to frame 43	Question: Find the number which make the following true (a) $\bigtriangledown + 4 = 9$ (b) $8 + \square = 10$ (c) $4 - \square = 2$ Step 3. Implement the plan (Students write down the answer to the question before checking the correct answer in page 57) Answer: Go to page 57

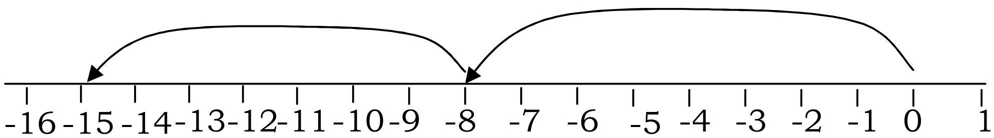
(a) (-9) – (-14) = -9 + 14 = + 5



(b) 19 – (-13) = 19 + 13 = 32



(c) -8 – (+7) = -8 -7 = -15



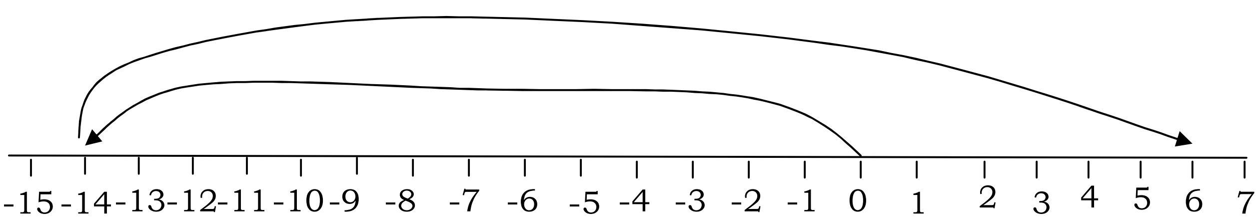
Step 1. Conceive a problem: use of symbols in open sentences and identification of coefficients

Step 2. Devise a plan: Students read through frame 46

56

Answer to frame 44	FRAME 46
6 paces to the south	Question: Find the value of the following if 4 goes into each shape.
(See the diagram below frame 46)	(a) △ + 2 + □ (b)6 + 5 +2 + △
Step 4.: Students look back to frame 44	Step 3. Implement the plan (Students write down the answer to the question before checking the correct answer in page 58)
	Answer: Go to page 58

-14 + (20) = -14 + 20 = +6



Step 1. Conceive a problem: use of symbols in open sentences and identification of coefficients

Step 2. Devise a plan :Students read through frame 47

Answer to frame 45	FRAME 47
(a) $\nabla + 4 = 9$ $\nabla = 9 - 4 = 5$ (b) $8 + \square = 10$ $:- \square = 10 - 8 = 2.$ (c) $4 - \square = 2$ $4 - 2 = \square$ $\square = 2.$ Step 4.: Students look back to frame 45	Question: What value makes the following statement true?. (a) $9 \times \square = 36$ (b) $\nabla \times 3 = 24$ Step 3. Implement the plan (Students write down the answer to the question before checking the correct answer in page 59) Answer: Go to page 59

Step 1. Conceive a problem: use of symbols in open sentences and identification of coefficients

Step 2. Devise a plan: Students read through frame 48

58

Answer to frame 46	FRAME 48
(a) $\triangle + 2 + \square = 4 + 2 + 4 = 10$ (b) $6 + 5 + 2 + \triangle = 6 + 5 + 2 + 4 = 17$ Step 4.: Students look back to frame 46	Question: Find the value of the following if 8 goes into each shape (a) $\triangle + \square + \square + 4$ (b) $5 + \quad +2 + \quad \square \quad \triangle$ Step 3. Implement the plan (Students write down the answer to the question before checking the correct answer in page 61) Answer: Go to page 61

Step 1. Conceive a problem: use of symbols in open sentences and identification of coefficients

Step 2. Devise a plan: Students read through frame 49

59

Answer to frame 47	FRAME 49
(a) $9 \times \square = 36$ $\square = {}^{36}/_{9} = 4$ (b) $\bigtriangledown \times 3 = 24$ $\bigtriangledown = {}^{24}/_{3} = 8$ Step 4.: Students look back to frame 47	Question: If every shape has an equal number, find the number in each shape (a) $\triangle = 14 - \square$ (b) $\square + \triangle = 10$ Step 3. Implement the plan (Students write down the answer to the question before checking the correct answer in page 62) Answer: Go to page 62

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Lesson 1(Week 6): USE OF LETTERS IN OPEN SENTENCES FRAME 50 - 52

Sub topic SIMPLE EQUATIONS

Objectives: By the time lesson comes to an end, individual students should be able, own their own, to:

(i) Find the value of letters in a given mathematical expressions

(ii) Solve simple equation by collecting like terms

.

Class Jss1

Duration 40 minutes

Step 1. Conceive a problem: use of letters in open sentences

Step 2. Devise a plan :Students read through frame 50

61

Answer to frame 48	FRAME 50
(a) $\square + \square + \triangle + 4 = 8 + 8 + 8 + 4$ $= 28$ (b) $5 + \square + 2 + \triangle = 5 + 8 + 2 + 8$ $= 23$ Step 4.: Students look back to frame 48	Question: Find the value of the following when S= 6 (a) S + S - 7 (b) 15 - S + S +2 Step 3. Implement the plan (Students write down the answer to the question before checking the correct answer in page 63) Answer: Go to page 63

Step 1. Conceive a problem: use of letters in open sentences

Step 2. Devise a plan :Students read through frame 51

62

Answer to frame 49	FRAME 51
(a) $\triangle = 14 - \square$ Since $\triangle = \square$ $2\triangle = 14$ $\triangle = 14/2$ $\triangle = 7 \quad , \square = 7$ (b) $\square + \triangle = 10$ Since $\square = \triangle$ $2\square = 10$ $\square = 10/2$ $\square = 5 \quad , \quad \triangle = 5$ Step 4.: Students look back to frame 49	Question: **:** Find the value of the letter in each of the following (a) $3x = 12$ (b) $13 + m = 26$ (c) $2r + 7 = 20 + r$ Step 3. Implement the plan (Students write down the answer to the question before checking the correct answer in page 65) Answer: Go to page 65

Step 1. Conceive a problem: use of letters in open sentences

Step 2. Devise a plan: Students read through frame 52

63

Answer to frame 50	FRAME 52
(a) $S + S - 7 = 6 + 6 - 7$ $= 12 - 7$ $= 5$ (b) $15 - S + S + 2 = 15 - 6 + 6 + 2$ $= 17$ Step 4.: Students look back to frame 50	Question: Find the value of the letter in each of the following (i) $4b - 8 = 20$ (ii) $2k + 4 = 36$ Step 3. Implement the plan (Students write down the answer to the question before checking the correct answer in page 66) Answer: Go to page 66

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Lesson 2(Week 6): WORD PROBLEMS FRAME 53 - 57

Sub topic TRANSLATION OF WORD PROBLEMS INTO MATHEMATICAL EXPRESSIONS

Objectives: By the time lesson comes to an end, individual students should be able, own their own, to:

(i) Translate word problems into mathematical expressions and solve the same.

(ii) Solve the mathematical expression formed in (i) above

Class Jss1

Duration 40 minutes

Step 1. Conceive a problem: Translation of word problems into mathematical expressions

Step 2. Devise a plan: Students read through frame 53

65

Answer to frame 51	FRAME 53
(a) $3x = 12$ Divide both sides by 3 ${}^{3x}/_{3} = {}^{12}/_{3}$ $X = 4.$ (b) $13 + m = 26$ Subtract 13 from both sides $13 – 13 + m = 26 – 13$ $m = 26$ (c) $2r + 7 = 20 + r$ Collect like terms $2r – r = 20 – 7$ $r = 13.$ Step 4.: Students look back to frame 51	Question: Sade is thinking of a number of which twice that number equals 8, find the number Step 3. Implement the plan (Students write down the answer to the question before checking the correct answer in page 67) Answer: Go to page 67

Step 1. Conceive a problem: Translation of word problems into mathematical expressions

Step 2. Devise a plan: Students read through frame 54

66

Answer to frame 52	FRAME 54
(i) $4b - 8 = 20$ Add 8 to both sides $4b - 8 + 8 = 20 + 8$ $4b = 28$ Divide both sides by 4 $4b/4 = 28/4$ $b = 7$ (ii) $2k + 4 = 36$ Subtract 4 from both sides $2k + 4 - 4 = 36 - 4$ $2k = 32$ Divide both sides by 2 $2k/2 = 32/2$ $K = 16$ Step 4.: Students look back to frame 52	Question: A company employs 2 carpenters and 3 bricklayers with total salary of the workers at the month to be ₦ 9000. If each bricklayer receives ₦ 500 more than the carpenters, find how much each worker receives? Step 3. Implement the plan (Students write down the answer to the question before checking the correct answer in page 68) Answer: Go to page 68

Step 1. Conceive a problem: Translation of word problems into mathematical expressions

Step 2. Devise a plan: Students read through frame 55

67

Answer to frame 53	FRAME 55
Let the number be x Twice the number $2x = 8$ Divide both sides by 2 $^{2x}/_{2} = {}^{8}/_{2} = 4$:- The number is 4.	Question :If a boy is to be paid ₦10 per day for casual work, how many days will he work to collect ₦150? Step 3. Implement the plan (Students write down the answer to the question before checking the correct

Step 4.: Students look back to frame 53	answer in page 69) Answer: Go to page 69

Step 1. Conceive a problem: Translation of word problems into mathematical expressions

Step 2. Devise a plan: Students read through frame 56

68

Answer to frame 54	FRAME 56
Let a represent the carpenters. So 2 carpenters = 2a Let b represents the bricklayers So 3 bricklayers = 3b Each bricklayer receives ₦500 more than the carpenters So 3b = 3 (b + ₦500) _____ (i) = 3b + ₦1500 Total number of workers = Total salary 2a + 3b + ₦1500 = ₦9000 If a =b 2a + 3a = ₦9000 - ₦1500 5a = ₦7500 a = ₦7500/5 = ₦1500 :- Each carpenter receives ₦1500 and each bricklayer receives ₦1500 + ₦500 = ₦2000 Step 4.: Students look back to frame 54	Question : Find the value of the following when t = 10 (a) t – 18 + t (b) t + 25 – 10 Step 3. Implement the plan (Students write down the answer to the question before checking the correct answer in page 71) Answer: Go to page 71

Step 1. Conceive a problem: Translation of word problems into mathematical expressions

Step 2. Devise a plan: Students read through frame 57

69

Answer to frame 55	FRAME 57
The boy receive =N=10 per day. To collect =N= 150, he has to work =N=150/=N=10 days = 15 days Step 4.: Students look back to frame 55	Question : Find the value of the letter in each of the following (a) $2P = 18 - P$ (b) $r – 2 = 28 – 2r$ Step 3. Implement the plan (Students write down the answer to the question before checking the correct answer in page 72) Answer: Go to page 72

APPENDIX IV

Lesson 1(Week 7): BASIC ALGEBRAIC OPERATIONS ON TERMS INVOLVING SYMBOLS FRAME 58- 61

Sub topic BODMAS

Objectives: By the time lesson comes to an end, individual students should be able, own their own, to:

(i) Apply the rules of BODMAS in simplifying simple algebraic expression

Class Jss1

Duration 40 minutes

Step 1. Conceive a problem: Basic Algebraic operations on terms involving symbols

Step 2. Devise a plan: Students read through frame 58

Answer to frame 56	FRAME 58
(a) t -18 + t = 10 – 18 + 10 = 20 – 18 = 2 (b) t + 25 – 10 = 10 + 25 – 10 = 35 – 10 = 25 Step 4.: Students look back to frame 56	Basic algebraic operations involve the use of basic arithmetic operations which are Addition, Multiplication, Subtraction and Division. In simplifying algebraic operations, this abbreviation could be helpful in ordering operations: BODMAS. B = Bracket O = Of D = Division M = Multiplication A = Addition S = Subtraction Question What is the full meaning of BODMAS Step 3. Implement the plan (Students write down the answer to the question before checking the correct answer in page 73) Answer: Go to page 73

Step 1. Conceive a problem: Basic Algebraic operations on terms involving symbols

Step 2. Devise a plan :Students read through frame 59

72

Answer to frame 57	FRAME 59
(i) $2p = 18 - p$ Add p to both sides $2p + p = 18 - p + p$ $3p = 18$ Divide both sides by 3 $3p/3 = 18/3$ $P = 6$ (ii) $r - 2 = 28 - 2r$ Collect like terms $r + 2r = 28 + 2$ $3r = 30$ Divide both sides by 3 $3r/3 = 30/3$ $r = 10$ Step 4.: Students look back to frame 57	Question :Simplify the following algebraic expressions (i) $2a + 12b$ (ii) $\frac{3(a-1)}{4} - {}^{1}/_{2}$ (iii) $\frac{a}{4} + \frac{(2a+1)}{3}$ Step 3. Implement the plan (Students write down the answer to the question before checking the correct answer in page 74) Answer: Go to page 74

Step 1. Conceive a problem: Basic Algebraic operations on terms involving symbols

Step 2. Devise a plan :Students read through frame 60

73

Answer to frame 58	FRAME 60
B = Bracket O = Of D = Division M = Multiplication A = Addition	Question : Simplify (a) 9b -18 (b) 2a +4b + 8 Step 3. Implement the plan (Students write down the answer to the question before checking the correct answer in page 76)

S = Subtraction Step 4.: Students look back to frame 58	Answer: Go to page 76

Step 1. Conceive a problem: Basic Algebraic operations on terms involving symbols

Step 2. Devise a plan: Students read through frame 61

74

Answer to frame 59	FRAME 61
(i) 2a + 12b = 2 (a + 6b) (ii) $\frac{3(a-1)}{4} - {}^{1}/_{2} = \frac{3(a-1)-2}{4}$ $= \frac{3a-3-2}{4} = \frac{3a-5}{4}$ (iii) $\frac{a}{4} + \frac{(2a+\ 1)}{3} = \frac{3a+4(2a+1)}{12}$ $= \frac{3a+8a+4}{12}$ = (11a + 4)/12 Step 4.: Students look back to frame 59	Question: Simplify (i) $\frac{6p}{2q} + \frac{p}{6q}$ (ii) $\frac{x+2}{6} - \frac{2x}{3}$ (iii) 3x – 2y + (6x - y). Step 3. Implement the plan (Students write down the answer to the question before checking the correct answer in page 77) Answer: Go to page 77

APPENDIX IV

INSTRUCTIONAL GUIDE FOR PROBLEM SOLVING STRATEGY (IGPSS)

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Lesson 2(Week 7): SIMPLE EQUATIONS WITH ONE VARIABLE AND THE USE OF EQUALITY SIGN FRAME 62- 65

Sub topic SIMPLE EQUATIONS WITH ONE VARIABLE AND THE USE OF EQUALITY SIGN

Objectives: By the time lesson comes to an end, individual students should be able, own their own, to:

i. Solve simple equation with one variable.

Class Jss1

Duration 40 minutes

Step 1. Conceive a problem: Basic Algebraic operations on terms involving symbols

Step 2. Devise a plan: Students read through frame 62

76

Answer to frame 60	FRAME 62
(i) 9b -18 = 9(b – 2) (ii) 2a +4b + 8 = 2(a + 2b + 4) Step 4.: Students look back to frame 60	Question : Find the unknown terms in the following algebraic equations (i) a + 19 = 28 (ii) $\frac{2x}{4} = 5$ (iii) 2 (x + 1) = 8 Step 3. Implement the plan (Students write down the answer to the question before checking the correct answer in page 78) Answer: Go to page 78

Step 1. Conceive a problem: Basic Algebraic operations on terms involving symbols

Step 2. Devise a plan: Students read through frame 63

77

Answer to frame 61	FRAME 63
(i) $\frac{6p}{2q} + \frac{p}{6q}$ = (18p + p)/6q = 19p/6q (ii) $\frac{x+2}{6} - \frac{2x}{3}$ = (x + 2 – 4x)/6 = (2 – 3x)/6 (iii) 3x – 2y + (6x - y) = 3x-2y+6x-y = 9x – 3y = 3 (3x – y) Step 4.: Students look back to frame 61	Question : Solve 2 (x + 1) = 8 Step 3. Implement the plan (Students write down the answer to the question before checking the correct answer in page 79) Answer: Go to page 79

Step 1. Conceive a problem: Basic Algebraic operations on terms involving symbols

Step 2. Devise a plan :Students read through frame 64

Answer to frame 62	FRAME 64
(i) a + 19 = 28 a = 28 – 19 = 9 (ii) $\frac{2x}{4} = 5$ Cross multiply 2x = 5 x 4 2x = 20 Divide both sides by 2 $\frac{2x}{2} = \frac{20}{2}$ X = 10 Step 4.: Students look back to frame 62	Question : Simplify M + 5 + M = 19 Step 3. Implement the plan (Students write down the answer to the question before checking the correct answer in page 81) Answer: Go to page 81

Step 1. Conceive a problem: Basic Algebraic operations on terms involving symbols

Step 2. Devise a plan: Students read through frame 65

Answer to frame 63	FRAME 65
2 (x + 1) = 8 2x + 2 = 8 2x = 8 – 2 2x = 6 Divide both sides by 2 $\frac{2x}{2} = \frac{6}{2}$ X = 3 Step 4.: Students look back to frame 63	Question : Solve 2q – 13 = 17 Step 3. Implement the plan (Students write down the answer to the question before checking the correct answer in page 82) Answer: Go to page 82

APPENDIX IV

INSTRUCTIONAL GUIDE FOR PROBLEM SOLVING STRATEGY (IGPSS)

80

Lesson 1(Week 8): TRANSLATING WORD SENTENCES INTO SIMPLE EQUATIONS

Sub topic WORD SENTENCE FRAME 66 - 70

Objectives: By the time lesson comes to an end, individual students should be able, own their own, to:

(i) Translate word sentences into simple equation and solve same.

Class Jss1

Duration 40 minutes

Step 1. Conceive a problem: Translating word sentences into simple equations

Step 2. Devise a plan: Students read through frame 66)

81

Answer to frame 64	FRAME 66
M + 5 + M = 19 Collect like terms 2M = 19 – 5 2M = 14 Divide both sides by 2 2M/2 = 14/2 M = 7 Step 4.: Students look back to frame 64	Question: A certain number plus 5 gives 9. Find the number Step 3. Implement the plan (Students write down the answer to the question before checking the correct answer in page 83) Answer: Go to page 83

Step 1. Conceive a problem: Translating word sentences into simple equations

Step 2. Devise a plan: Students read through frame 67

82

Answer to frame 65	FRAME 67
2q – 13 = 17**,** Collect like terms 2q =17 + 13 2q = 30 Divide both sides by 2	Question **:** Emeka added up his marks leaving behind 6marks due to a mistake to get 25marks; how many marks had he got at first? Step 3. Implement the plan (Students write down the

2q/2 = 30/2 q= 15 Step 4.: Students look back to frame 65	answer to the question before checking the correct answer in page 84) Answer: Go to page 84

Step 1. Conceive a problem: Translating word sentences into simple equations

Step 2. Devise a plan: Students read through frame 68

83

Answer to frame 66	FRAME 68
Let y be the number y + 5 = 9 Collect like terms y = 9 – 5 y = 4 Step 4.: Students look back to frame 66	Question**:** The square of certain number is 16. Find the number Step 3. Implement the plan (Students write down the answer to the question before checking the correct answer in page 85) Answer: Go to page 85

Step 1. Conceive a problem: Translating word sentences into simple equations

Step 2. Devise a plan: Students read through frame 69

84

Answer to frame 67	FRAME 69
Let Emeka total marks be K. K – 6 = 25 K = 25 + 6 K = 31 So Emeka had 31 mark at first Step 4.: Students look back to frame 67	Question**:** The difference between seven times a number and five is sixteen. Find the number. Step 3. Implement the plan (Students write down the answer to the question before checking the correct answer in page 1) Answer: Go to page 1

Step 1. Conceive a problem: Translating word sentences into simple equations

Step 2. Devise a plan: Students read through frame 70

85

Answer to frame 68	FRAME 70
Let the number be S $S^2 = 16$ Take the square root of both sides $\sqrt{S^2} = \sqrt{16}$ S = 4. Step 4.: Students look back to frame 68	Question**:** In a school there are 46 more girls than boys. Altogether there are 380 children. How many boys are there in the school? . Step 3. Implement the plan (Students write down the answer to the question before checking the correct answer in page 2) Answer: Go to page 2

Text Editing

Instruction: This section contains 12 problems. Each problem contains either

(1) Enough information for you to solve it or

(2) Some information which you do not require in order to solve the problem (irrelevant information to be underlined) or

(3) No enough information for you to solve it (missing information to be supplied).

Example 1

Estimate 0.74 – 0.53

This problem contains:

Solution

Estimate 0.74 – 0.53

This problem contains:

(1) Sufficient information to solve it.

Example 2

Round up 0.032 to the nearest hundredth neglecting the last digit.

This problem contains:

Solution

Round up 0.032 to the nearest hundredth neglecting the last digit.

This problem contains:

(2) Irrelevant information underlined

Example 3

Convert 1234 to base 10

This problem contains:

Solution

Convert 1234 to base 10

This problem contains:

(3) Missing information to be supplied. The problem does not tell us what base 1234 is

Problem 1

Estimate 63 x 41

This problem contains:

Problem 2

Round up 0.1523 to one decimal place

This **problem contains:**

Problem3

A match box has a mass of 100g. If there are 20 match sticks in the box, estimate the mass of a match stick to 1 significant figure disregarding the fact that there are different sizes of match boxes.

This problem contains:

Problem 4

Convert 1101_2 to another base

This problem contains:

Problem 5

Calculate 1011 + 111 in base two.

This problem contains:

Problem 6

What is the place value of this digit in 0.1214

This problem contains:

Problem 7

Evaluate (+ 2) – (- 4)

This problem contains:

Problem 8

In the box provided put where appropriate in the box and show all workings 5 $\square$ - 2

This problem contains

Problem 9

Ojo moved 10 paces to the North, and then moved 15 paces to the South although he had intention to go to the east. What is his final position?

This problem contains:

Problem 10

Biola is thinking of a number of which twice that number equals 6. Find the number and guess what she's thinking about

This problem contains:

Problem 11

=N= 30 is to be shared equally among several boys. If one of the boys spent 76 kobo out of his share. How much does he have left?

This problem contains:

Problem 12

Simplify ab + 2b if a is not equal to b

This problem contains:

SOLUTIONS TO THE 12 STATED PROBLEMS

Problem 1

Estimate 63 x 41

This problem contains:

(1) Sufficient in formation

Problem 2

Round up 0.1523 to one decimal place

This problem contains**:**

(1) Sufficient in formation

Problem3

A match box has a mass of 100g. If there are 20 match sticks in the box, estimate the mass of a match stick to 1 significant figure <u>disregarding the fact that there are different sizes of match boxes.</u>

This problem contains:

(2) Irrelevant information underlined

Problem 4

Convert 1101_2 to another base

This problem contains:

(3) Missing information supplied. The problem does not tell us what another based implies

Problem 5

Calculate 1011 + 111 in base two.

This problem contains:

(1) Sufficient in formation

Problem 6

What is the place value of this digit in 0.1214

This problem contains:

(3) Missing information supplied. The problem does not tell us the actual digit the place value is to be determined.

Problem 7

Evaluate (+ 2) – (- 4)

This problem contains:

(1) Sufficient in formation

Problem 8

In the box provided put where appropriate in the box and show all workings 5 $\boxed{}$ - 2

This problem contains:

(3) Missing information supplied: The problem does not tell us what to put in the box

Problem 9

Ojo moved 10 paces to the North, and then moved 15 paces to the South <u>although he had intention to go to the east</u>. What is his final position?

This problem contains:

(2) Irrelevant information underlined

Problem 10

Biola is thinking of a number of which twice that number equals 6. Find the number and guess what she's thinking about

This problem contains:

(2) Irrelevant information underlined

Problem 11

=N= 30 is to be shared equally among several boys. If one of the boys spent 76 kobo out of his share. How much does he have left?

This problem contains:

(3) Missing information supplied. The problem does not tell us how many boys shared the money

Problem 12

Simplify ab + 2b if a is not equal to b

This problem contains:

(2) Irrelevant information underlined.

APPENDIX V

INSTRUCTIONAL GUIDE ON CONVENTIONAL TEACHING STRATEGY (IGCTS)

Required materials

Mathematics notebook(s), writing materials, ruler and pencil

An 8 week Conventional Method Package for J.S.S 1students

Week	Contents
Week 1	
Period 1	Approximation
Period 2	Rounding up of numbers and significant figures
Week 2	
Period 1	Approximation in everyday activities
Period 2	Number bases
Week 3	
Period 1	Operations with binary numbers
Period 2	Basic operations
Week 4	
Period 1	Place value
Period 2	Integers
Week 5	
Period 1	Ordering of numbers
Period 2	Algebraic process
Week 6	
Period 1	Use of letters in open sentences
Period 2	Word problems
Week 7	
Period 1	Algebraic operations on terms involving symbols
Period 2	Simple equations with one variable and the use of equality sign
Week 8	
Period 1	Translating word sentences into simple equations.

APPENDIX V

INSTRUCTIONAL GUIDE ON CONVENTIONAL TEACHING STRATEGY (IGCTS)

Week 1

Lesson 1

Topic	APPROXIMATION
Sub topic	DECIMAL PLACES AND SIGNIFICANT FIGURES.
Objectives:	By the time lesson comes to an end, individual students should be able, own their own, to: (i) Determine how accurate the degree of accuracy of a given number (ii) determine degree of accuracy of a given number.
Class	Jss1
Duration	40 minutes

Step 1: Teacher introduces the topic

Approximation simply means obtaining the degree of accuracy of numbers.

Types of Approximation are (a) Decimal places (b) Significant figures

(a) Decimal places: This simply states the numbers of digits after the decimal.

Step ii : Teacher explain the concepts been thought with examples

Example 1

(i) 0.45 has one decimal place

(ii) 0.72 has two decimal places

(iii) 0.056 has three decimal places

Example 2: Estimate the following

(a) 31 + 63 (b) 67 – 36 (c) 7.2 X 9.8 (d) 46 ÷ 23

Solution

(a) 31 + 63 = 94 – Actual Calculation

Approximation is 30 + 60 = 90

(b) 67 – 36 = 31 – Actual Calculation

Approximation is 70 – 40 =30

(c) 7.2 X 9.8

7. 2
X 9. 8
576
648
70.56

Approximation is 7.0 x 10 = 70

(d) 46 ÷ 23= 2

$$23\overline{\big)46}$$
46
00

Approximation is 50 ÷ 20= 2

Step iii Teacher instructed the students to copy note from the chalk board

Step iv: Teacher evaluated by giving the students class and home work

Class work

Estimate (a) 43 + 62 + 59 (b) 53 – 38 (c) 17 X 42

WEEK 1 LESSON 1 CLASS WORK

Solution

(a) 43 + 62 + 59 = 164 - Actual Calculation

Approximation is 40+ 60 + 60 = 160

(b) 53 – 38 = 15 – Actual Calculation

Approximation is 50 – 40 = 10

(c) 1 7
X 4 2
3 4
6 8
7 1 4 - Actual Calculation

Approximation is 17 x 40 = 680

Home work

Estimate the following

(a) 0.00092 – 0.00057 (b) 0.74 – 0.53 (c) 0.81 ÷ 0.22

APPENDIX V

INSTRUCTIONAL GUIDE ON CONVENTIONAL TEACHING STRATEGY (IGCTS)

Week 1

Lesson 2

Topic	ROUNDING UP OF NUMBERS AND SIGNIFICANT FIGURES
Sub topic	DECIMAL PLACES AND SIGNIFICANT FIGURES.
Objectives:	By the time lesson comes to an end, individual students should be able, own their own, to round up numbers in giving significant figures, decimal places, nearest whole numbers, hundreds, thousands, tenth, hundredth and thousandth.
Class	Jss1
Duration	40 minutes

Step 1: Teacher introduces the topic

Answer to mathematical question can be approximated to a whole number, significant figures or decimal places. A number from 0 to 4 are rounded down as zero while a number from 5 to 9 are rounded up as one.

Step ii : Teacher explain the concepts been thought with examples

Example 1

Convert the following into (a) 1 decimal place (b) 2 decimal places (c) 3 decimal places (i) 0.00159 (ii) 8.6456 (iii) 19.6545

Solution

(a) Rounding up to 1 decimal place

(i) 0.00159 = 0.0

(ii) 8.6456 = 8.6

(iii) 19.6545 = 19.7

(b) Rounding up to 2 decimal places

(i) 0.00159 = 0.00

(ii) 8.6456 = 8.65

(iii) 19.6545 = 19.65

(c) Rounding up to 3 decimal places

(i) 0.00159 = 0.002

(ii) 8.6456 = 8.646

(iii) 19.6545 = 19.655

Example 2: Round up 415, 762 correctly up to the nearest

(a) Ten (b) Hundred (c) Thousand (d) Ten thousand

Solution

(a) 415, 762 = 415, 760 to the nearest 10

(b) 415, 762 = 415, 800 to the nearest 100

(c) 415, 762 = 416, 000 to the nearest 1000

(d) 415, 762 = 420, 000 to the nearest 100, 000

Example 3: Round up 0.79874 to the nearest

(a) Tenth (b) Hundredth (c) Thousandth (d) Whole number.

Solution

(a) 0.79874 = 0.8 to nearest tenth.

(b) 0.79874 = 0.80 to nearest hundredth

(c) 0.79874 = 0.799 to nearest thousandth

(d) 0.79874 = 1.0 to nearest whole number.

Example 4: Round up (a) 713 (b) 0.275 to one significant figure

Solution

(a) 713 = 700 to one significant figure

(b) 0.275 = 0.3 to one significant figure

Step iii Teacher instructed the students to copy note from the chalk board

Step iv: Teacher evaluated by giving the students class and home work

Class work

1. Round up 8.6478 to (a) 2 significant figure (b) 3 decimal places (c) nearest thousandth.

WEEK 1 LESSON 2 CLASS WORK

Solution

(a) 8.6478 = 860 to 2 significant figure

(b) 8.6478 = 8.648 to 3 decimal places

(c) 8.6478 = 8.648 to nearest thousandth

Home work

1. Round up (a) 4268 (b) 3907 to the nearest thousand
2. Round up 8019.674 to (a) 1 decimal place (b) 1 significant figure (c) nearest hundredth.

APPENDIX V

INSTRUCTIONAL GUIDE ON CONVENTIONAL TEACHING STRATEGY (IGCTS)

Week 2

Lesson 1

Topic	APPROXIMATION IN EVERYDAY ACTIVITIES
Sub topic	ROUNDING UP OF NUMBERS
Objectives:	By the time lesson comes to an end, individual students should be able, own their own, to: i Acquire certain level of competence in determining the degree of accuracy of numbers. ii Solve problems on rounding up of numbers.
Class	Jss1
Duration	40 minutes

Step ii : Teacher explain the concepts been thought with examples

Example 1: Round up

(a) 175 kg to the nearest 10 kg

(b) 5538 grammes to the nearest 100 grammes

(c) 62435 tonnes to the nearest 1000 tonnes

Solution

(a) 175 kg = 180 kg to the nearest 10 kg

(b) 5538 grammes = 5500 grammes

(c) 62435 tonnes = 62,000 tonnes

Example 2: Round up the following to the nearest cm

(a) 23.7cm (b) 6.5cm (c) 8.1cm

Solution

(a) 23.7cm = 24cm

(b) 6.5cm = 7cm

(c) 8.1cm = 8cm

Example 3: A packet of sweets has a mass of 185g. if there are 26 sweets in the packets, estimate the mass of sweet to 1 significant figure.

Solution

185g÷26= 7

$$26\overline{)185}$$
$$\underline{182}$$
$$3$$

∴ The mass of sweet is 7g to 1 significant figure

Example 4: If one tuber of yam cost ₦1.85k, estimate the cost of 17 tubers

Solution

1 tuber of yam cost ₦1.85k

17 tubers of yam will cost ₦1.85k x 17

= 1.8 5

X 1 7

1295

185

₦31. 45

₦ 31.45 is approximately ₦ 31.

Step iii Teacher instructed the students to copy note from the chalk board

Step iv: Teacher evaluated by giving the students class and home work

Class work: Round up the following

(a) 10382km to the nearest 100km

(b) 73. 2kg, 8.67kg, 15.7kg to the nearest kg.

WEEK 2 LSSON 1 CLASS WORK

Solution

(a) 10382km = 10400km to the nearest 100km

(b) 732 kg = 70kg

(c) 8.67kg = 9kg

(d) 15.7kg = 16kg

Home work

Approximate to 1 significant figure how much naira each person can get if ₦15,000.50k is to be shared equally among 50 persons.

APPENDIX V

INSTRUCTIONAL GUIDE ON CONVENTIONAL TEACHING STRATEGY (IGCTS)

Week 2

Lesson 2

Topic	NUMBER BASE
Sub topic	CONVERSION OF NUMBER FROM BASE TEN TO BASE TWO AND BASE TWO TO BASE TEN
Objectives:	By the time lesson comes to an end, individual students should be able, own their own, to: i Convert numbers from base ten to base two ii Convert numbers from base two to base ten.
Class	Jss1
Duration	40 minutes

Step i : Teacher introduces the lesson

Counting in base two: Base two numbers or binary number is made up of only two digits: 0 and 1while denary numbers (base 10) have ten digits: 0, 1, 2, 3, 4, 5, 6, 7, 8, and 9.

Step ii : Teacher explain the concepts been thought with examples

Example 1: Convert the following base ten numbers into binary number (a) 26 (b) 39.

Solution

(a)

2 | 26
2 | 13 r 0
2 | 6 r 1
2 | 3 r 0
  | 1 r 1

$26 = 11010_2$

(b)

2 | 39
2 | 19 r 1
2 | 9 r 1
2 | 4 r 1
2 2 r 0
2 | 1 r 0

$39 = 100111_2$

Example 2: Convert the following binary numbers into base ten numbers (a) 1101 (b) 10000

Solution

(a) $1101_2 = 1 \times 2^3 + 1 \times 2^2 + 0 \times 2^1 + 1 \times 2^0$

$= 8 + 4 + 0 + 1$

$= 13$

(b) $10000_2 = 1 \times 2^4 + 0 \times 2^3 + 0 \times 2^2 + 0 \times 2^1 + 0 \times 2^0$

$= 16 + 0 + 0 + 0 + 0$

$= 16$

Example 3: Find the value of the following leaving your answer in base two $(110_{two})^2$

Solution

$110_{two} = 1 \times 2^2 + 1 \times 2^1 + 0 \times 2^0$

$= 4 + 2 + 0$

$= 6$

$(110_{two})^2 = (6_{ten})^2$

$= 36$

Convert to base 2

2 | 36

2 | 18 r 0

2 | 9 r 0

2 | 4 r 1

2 | 2 r 0

| 1 r 0

$100100_{two} = 36$

Step iii Teacher instructed the students to copy note from the chalk board

Step iv: Teacher evaluated by giving the students class and home work

Class work

Convert (a) 32 (b) 65 to binary numbers.

WEEK 2 LESSON 2 CLASS WORK

Solution (a)

$$\begin{array}{r|l}
2 & 32 \\ \hline
2 & 16 \text{ r } 0 \\ \hline
2 & 8 \text{ r } 0 \\ \hline
2 & 4 \text{ r } 0 \\ \hline
2 & 2 \text{ r } 0 \\ \hline
 & 1 \text{ r } 0
\end{array}$$

$32 = 100000_{two}$

(b) **Solution** (a)

$$\begin{array}{r|l}
2 & 65 \\ \hline
2 & 32 \text{ r } 0 \\ \hline
2 & 16 \text{ r } 0 \\ \hline
2 & 8 \text{ r } 0 \\ \hline
2 & 4 \text{ r } 0 \\ \hline
2 & 2 \text{ r } 0 \\ \hline
 & 1 \text{ r } 0
\end{array}$$

$65 = 1000001_{two}$

Home work

1. Convert the following binary number into base ten numbers (a) 10101 (b) 111000
2. Find the value of $(1000_{two})^2$, leaving your answers in base two.

APPENDIX V

INSTRUCTIONAL GUIDE ON CONVENTIONAL TEACHING STRATEGY (IGCTS)

Week 3

Lesson 1

Topic OPERATIONS WITH BINARY NUMBERS

Sub topic BASIC OPERATIONS IN BASE TWO

Objectives: By the time lesson comes to an end, individual students should be able, own their own, to:

i Count, add, subtract and multiply numbers in base two.

Class Jss1

Duration 40 minutes

Step I; Teacher introduces the lesson

Step ii Teacher explain the concept been thought with examples

Example 1: Calculate the following in base two

(a) 111 (b) 101 (c) 1110 (d) 11101 (e) 1110

+ 1 +101 -1101 x 111 x 110

Solution

(a) 111 (b) 101 (c) 1110

+ 1 +101 -1101

1000 1010 01

(d) 11101 (e) 1110

x 111 x 110

11101 0000

11101 1110

11101 1110

11001011 1010100

Step iii Teacher instructed the students to copy note from the chalk board

Step iv: Teacher evaluated by giving the students class and home work

Class work

Calculate (a) $\begin{array}{r} 11 \\ +101 \\ \hline \\ \hline \end{array}$ (b) $\begin{array}{r} 10 \\ \times 10 \\ \hline \\ \hline \end{array}$ (c) $\begin{array}{r} 11110 \\ -1101 \\ \hline \\ \hline \end{array}$

WEEK 3 LESSON 1 CLASS WORK

(a) $\begin{array}{r} 1\ 1 \\ +\ 1\ 0\ 1 \\ \hline 1\ 0\ 0\ 0 \\ \hline \end{array}$ (b) $\begin{array}{r} 1\ 0 \\ \times\ 1\ 0 \\ \hline 0\ 0 \\ 1\ 0\ \ \\ \hline 1\ 0\ 0 \\ \hline \end{array}$ (c) $\begin{array}{r} 1\ 1\ 1\ 1\ 0 \\ -\ 1\ 1\ 0\ 1 \\ \hline 1\ 0\ 0\ 0\ 1 \\ \hline \end{array}$

Home work

Calculate $110_{two} \times (1011_{two} + 1001_{two} - 101_{two})$

APPENDIX V

INSTRUCTIONAL GUIDE ON CONVENTIONAL TEACHING STRATEGY (IGCTS)

Week 3

Lesson 2

Topic BASIC OPERATIONS

Sub topic PLACE VALUE

Objectives: By the time lesson comes to an end, individual students should be able, own their own, to:

i Add and subtract numbers with emphasis on place value.

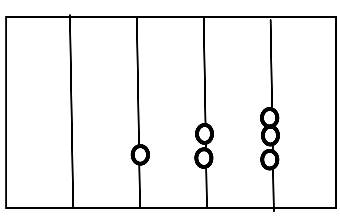
Class Jss1

Duration 40 minutes

Step I; Teacher introduces the lesson

Counting Device: The Abacus

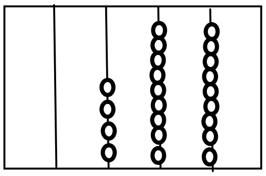
Abacus is probably the first counting device, it have wires or rods on which counters could freely move back and forth. Each wire corresponds to a digit in a positional number system commonly in base 10.

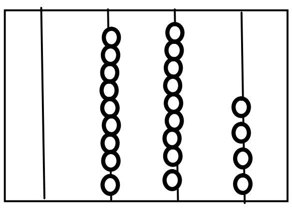
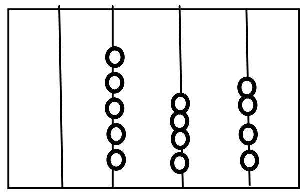
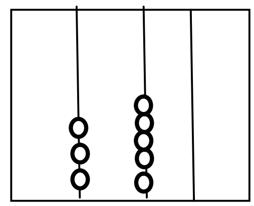


= 123

Step ii Teacher explain the concept been thought with examples

Example 1 use an abacus to (a) add 102 + 54 + 34 (b) represent 894 – 544

(a)  = 499

(b)  894 -  544  = 350

Step iii Teacher instructed the students to copy note from the chalk board

Step iv: Teacher evaluated by giving the students class and home work

Class work

(1) Use an abacus to represent (a) 1982 (b) 78 (c) 74 + 21

Home work

(1) Use an Abacus to represent (a) 236 – 162 (b) 452 - 326

APPENDIX V

INSTRUCTIONAL GUIDE ON CONVENTIONAL TEACHING STRATEGY (IGCTS)

Week 4

Lesson 1

Topic PLACE VALUE

Sub topic ADDITION, SUBTRACTION AND PLACE VALUE

Objectives: By the time lesson comes to an end, individual students should be able, own their own, to:

i Add and subtract numbers with emphasis on place values.

Class Jss1

Duration 40 minutes.

Step I; Teacher introduces the lesson

The Hindu-Arabic number system [0 1 2 3 4 5 6 7 8 9] has the place value number different from previous number systems

Digit	**System**	**Symbol**
1	Unit	U
10	Ten	T
100	Hundred	H
1,000	Thousand	TH
10,000	Ten Thousand	TTH
100,000	Hundred Thousand	HTH
1,000,000	Million	M

Step ii Teacher explain the concept been thought with examples

Example 1: Write down the place value of (a) 406 (b) 6024

Solution

(a) 4 0 6

hundred ten unit

(b) 6 0 2 4

thousand hundred ten unit

Example 2: Write down the place value of each number in the following (a) 2.105 (b) 61.01 (c) 0.1265

Solution

(a)

2	.	1	0	5
unit	decimal point	tenth	hundredth	thousandth

(b)

6	2	1	.	0	1
hundred	tens	unit	decimal point	tenth	hundredth

(c)

0	.	1	2	6	5
		tenth	hundredth	**thousandth**	ten thousandth

Step iii Teacher instructed the students to copy note from the chalk board

Step iv: Teacher evaluated by giving the students class and home work

Class work

(1) Write down the place-value of each number in the following (a) 1204 (b) 238.614

WEEK 4 LESSON 1 CLASS WORK

Solution

(a)

1	2	0	4
Thousand	Hundred	Ten	Unit

(b)

2	3	8.	6	7	4
Hundred	Ten	Unit	Tenth	Hundredth	Thousandth

Home work

(1) What is the value of the following in the numbers below? (a) 3 in 6302 (b) 5 in 0.053 (c) 2 in 3982.

APPENDIX V

INSTRUCTIONAL GUIDE ON CONVENTIONAL TEACHING STRATEGY (IGCTS)

Week 4

Lesson 2

Topic	INTEGERS
Sub topic	ADDITION AND SUBTRACTION OF POSITIVE AND NEGATIVE INTEGERS
Objectives:	By the time lesson comes to an end, individual students should be able, own their own, to: i Add, subtract positive and negative integers.
Class	Jss1
Duration	40 minutes

Step i: Teacher introduces the lesson

Integers are numbers positive or negative $\pm 1 \ \pm 2 \ \pm 3 \ \pm 4$ etc.

(1) Addition of Directed Numbers

Note the following rules of signs

+ x + = +

+ x - = -

- x - = +

- x + = -

Algebraic Addition is the collection together using certain particular rules as stated above.

Step ii Teacher explain the concept been thought with examples

Example: Evaluate (a) (+3) + (-5) (b) (+10) + (-8) (c) (+4) + (+12)

Solution

(a) (+3) + (-5) = + (3-5) = -2

(b) (+10) + (-8) = + (10 - 8) = +2

(c) (+4) + (+12) = + (4 + 12) = +16

(2) Subtraction of Direct Numbers

Example: Evaluate (a) (+30) – (-10) (b) (-13) – (+10) (c) (-4) – (-16)

Solution

(a) (+30) – (-10) = + (30 + 10) = +40

(b) (-13) – (+10) = - (13 + 10) = -23

(c) (-4) – (-16) = (-4 + 16) = +12

Step iii Teacher instructed the students to copy note from the chalk board

Step iv: Teacher evaluated by giving the students class and home work

Class work

Evaluate (a) (+2) + (+6) (b) (+7) + (-5) (c) (-8) – (-9)

WEEK 4 LESSON 2 CLASSWORK

Solution

(a) (+2) + (+6) = +8

(b) (+14) - (-20) = +14 + 20 = +34

(c) (-17) – (-8) = -17 + 8 = - 9

Home work

Evaluate (-23) + (-9) (b) (+14) – (-20) (c) (-17) – (-8)

APPENDIX V

INSTRUCTIONAL GUIDE ON CONVENTIONAL TEACHING STRATEGY (IGCTS)

Week 5

Lesson 1

Topic ORDERING OF NUMBERS

Sub topic USE OF SYMBOLS IN OPEN SENTENCES, ACENDING AND DESCENDING ORDER, NUMBERLINE

Objectives: By the time lesson comes to an end, individual students should be able, own their own, to:

i Use symbol in open sentences in carrying out arithmetic operations

ii Arrange numbers in ascending and descending orders

iii Represent integers on number lines.

Class Jss1

Duration 40 minutes

Step iii Teacher introduces the lesson

Numbers may be arranged in ascending order that is from smaller to larger ones or in descending order, larger to smaller ones. We need the following signs to do this:

(1) $=$ equal to

(2) $\neq$ not equal to

(3) $\simeq$ is about equal to or nearly equal to

(4) $>$ greater than

(5) $\geq$ greater than or equal to

(6) $<$ less than

(7) $\leq$ less than or equal to

Step iii Teacher explain the concepts been thought with example

Example 1: In the box provided put in < or > where appropriate

(a) 5 $\boxed{}$ -10 (b) -5 $\boxed{}$ 10 (c) 3 $\boxed{}$ 15

Solution

(a) 5 $\boxed{>}$ - 10 (b) -5 $\boxed{<}$ 10 (c) 3 $\boxed{<}$ 15

Example 2: Arrange the following in ascending order (a) 14, 8, 16 (b) -8, -4, -6, -14.

Solution

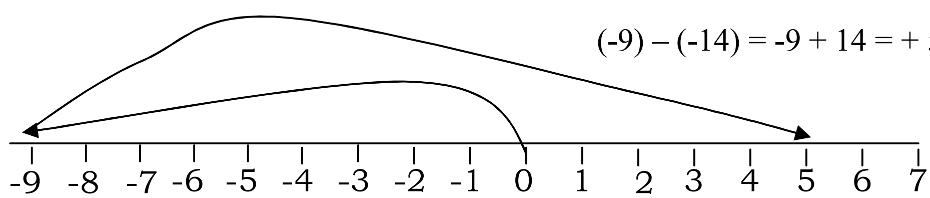
(a) 14, 8, 16 = 8, 14, 16 in ascending order

(b) -8, -4, -6, -14 = -14, -8, -6, -4 in ascending order

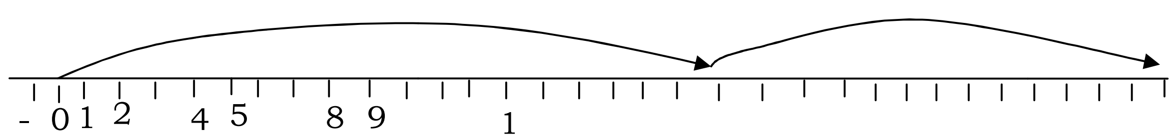
Example 3: (a) (-9) – (-14) (b) 19 – (-13) (c) -8 – (+7). Evaluate with diagram

Solution

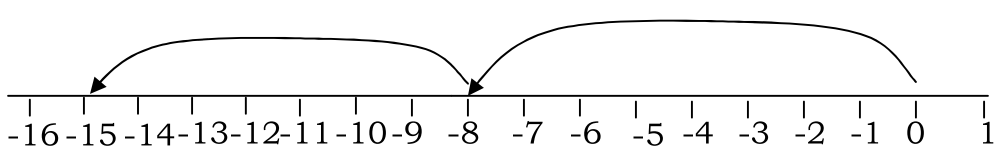
(a) (-9) – (-14) = -9 + 14 = + 5



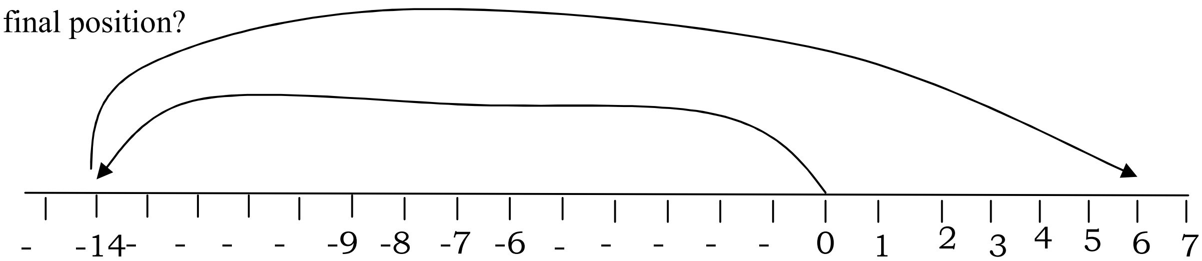
(b) 19 – (-13) = 19 + 13 = 32



(c) -8 – (+7) = -8 -7 = -15



Example 3: Oluade moved 14 paces to the North, then moved 20 paces to the south. What is his final position?



-14 + (20) = -14 + 20 = +6

Step iii Teacher instructed the students to copy note from the chalk board

Step iv: Teacher evaluated by giving the students class and home work

Class work

(1) Write either true or false (a) $-8 < 2$ (b) $+10 <- 21$ (c) $+39 > -2$.

(2) Arrange in descending order +8, -82, -7, 0, +3

Week 5 lesson 1 class work

Solution

1(a). $-8 < 2$ = True

(b) $+10 < -21$ = False

(c) $+39 > -2$ = True

(2) +8, -82, -7, 0, +3, = 8, 3, 0, -7, -82 in descending order

Home work

Evaluate using number line (a) (-5) + 8 (b) 3 + (-6)

APPENDIX V

INSTRUCTIONAL GUIDE ON CONVENTIONAL TEACHING STRATEGY (IGCTS)

Week 5

Lesson 2

Topic ALGEBRAIC PROCESSES

Sub topic USE O SYMBOLS IN OPEN SENTENCES AND IDENTIFICATION OF COEFFICIENTS .

Objectives: By the time lesson comes to an end, individual students should be able, own their own, to:

i Use symbol in open sentences in carrying out arithmetic operations

ii Identify coefficients of terms of a given algebraic expressions.

Class Jss1

Duration 40 minutes

Step i: Teacher introduces the lesson

Step ii: Teacher explains the concepts been thought with examples

Example 1: Find the numbers which make the following statements true

(a) $\bigtriangledown + 4 = 9$ (b) $8 + \bigtriangledown = 10$ (c) $4 - \bigtriangledown = 2$

Solution

(a) $\bigtriangledown + 4 = 9$

$\bigtriangledown = 9 - 4 = 5$

(b) $8 + \square = 10$

:- $\square$ $10 – 8 = 2$.

(c) $4 - \square = 2$

$4 – 2 = \square$

$\square = 2$.

Example2: Find the value of the following if 4 goes into each shape.

(b) $\triangle + 2 + \square$ (b)$6 + 5 + 2 + \triangle$

Solution

(a) $\triangle + 2 + \square = 4 + 2 + 4 = 10$

(c) $6 + 5 + 2 + \triangle = 6 + 5 + 2 + 4 = 17$

Example3: What values makes the following statements true?

(b) $9 \times \square = 36$ (b) $\bigtriangledown \times 3 = 24$

Solution:

(a) $9 \times \square = 36$

$\square = {}^{36}/_{9} = 4$

(b) $\bigtriangledown X\ 3 = 24$

$\bigtriangledown = {}^{24}/_{3} = 8$

Step iii Teacher instructed the students to copy note from the chalk board

Step iv: Teacher evaluated by giving the students class and home work

Class work

(1) Find the value of the following of 8 goes into each shape

1. $\square + \square + \bigtriangledown + 4$ (b) $5 + \bigtriangledown + 2 + \square$

(2) What will make this statement true $12 = \triangle - 5$

WEEK 5 LESSON 2 CLASS WORK

Solution

1(a) $\square + \square + \bigtriangledown + 4$, if 8 goes into each shape $= 8 + 8 + 8 + 4 = 28$

(b) $5 + \bigtriangledown + 2 + \square$, if 8 goes into each shape $= 5 + 8 + 2 + 8 = 23$

2. $12 = \triangle - 5$

$\triangle = 12 + 5$ collecting like terms

$\triangle = 17$

Home work

(1) Find the value of this statement if 12 goes into each figure

$4 + \triangle + \square - \square$

(2) If every shape has an equal number, find the number in each box

(i) $\triangle = 14 - \square$ (ii) $\triangle + \square = 10$

APPENDIX V

INSTRUCTIONAL GUIDE ON CONVENTIONAL TEACHING STRATEGY (IGCTS)

Week 6

Lesson 1

Topic USE OF LETTERS IN OPEN SENTENCES

Sub topic SIMPLE EQUATIONS

Objectives: By the time lesson comes to an end, individual students should be able, own their own, to:

i Find the value of letters in a given mathematical expressions

ii Solve simple equation by collecting like terms

Class Jss1

Duration 40 minutes

Step I: Teacher introduces the lesson

Step ii: Teacher explains the concept been thought with examples

Example1: Find the value of the following when S=6

(a) S + S – 7 (b) 15 – S + S + 2

Solution:

1. S + S – 7 = 6 + 6 – 7
   = 12 – 7 = 5
2. 15 – S + S + 2 = 15 – 6 + 6 + 2
   = 17

Example2: Find the value of the letter in each of the following

(a) 3x = 12 (b) 13 + m = 26 (c) 2r + 7 = 20 + r

Solution:

(a) 3x = 12

Divide both sides by 3

$^{3x}/_{3} = {}^{12}/_{3}$

X = 4.

(b) 13 + m = 26

Subtract 13 from both sides

$13 - 13 + m = 26 - 13$

$m = 26$

(c) $2r + 7 = 20 + r$

Collect like terms

$2r - r = 20 - 7$

$r = 13.$

Step iii Teacher instructed the students to copy note from the chalk board

Step iv: Teacher evaluated by giving the students class and home work

Class work: Find the value of the letter in each of the following

(i) $4b - 8 = 20$ (ii) $2k + 4 = 36$

WEEK 6 LESSON 1 CLASS WORK

Solution

(1) $4b - 8 = 20$

Collect like terms

$4b = 20 + 8$

$4b = 28$

Divide both sides by 4

$$\frac{4b}{4} = \frac{28}{4}$$

$b = 7$

(II) $2k + 4 = 36$

Collect like terms

$2k = 36 - 4$

$2k = 32$

Divide both sides by 2

$$\frac{2k}{2} = \frac{32}{2}$$

$K = 16$

Home work: Find the value of the following when y=10. (i) y-2+y

(ii) 3y – 5 + 6

APPENDIX V

INSTRUCTIONAL GUIDE ON CONVENTIONAL TEACHING STRATEGY (IGCTS)

Week 6

Lesson 2

Topic WORD PROBLEMS

Sub topic TRANSLATION OF WORD PROBLEMS INTO MATHEMATICAL EXPRESSIONS

Objectives: By the time lesson comes to an end, individual students should be able, own their own, to:

i. Translate word problems into mathematical expressions and solve the same.

ii. Solve the mathematical expression formed in (i) above

.

Class Jss1

Duration 40 minutes

Step i:Teacher introduces the lesson

Step ii: Teacher explains the concept been thought with examples

Example1: Sade is thinking of a number of which twice that number equals 8, find the number.

Solution

Let the number be x

Twice the number 2x = 8

Divide both sides by 2

$^{2x}/_2 = {}^8/_2 = 4$

:- The number is 4.

Example 2: A company employs 2 carpenters and 3 bricklayers with total salary of the workers at the month to be ₦ 9000. If each bricklayer receives ₦ 500 more than the carpenters, find how much each worker receives?

Solution

Let a represent the carpenters.

So 2 carpenters = 2a

Let b represents the bricklayers

So 3 bricklayers = 3b

Each bricklayer receives ₦500 more than the carpenters

So 3b = 3 (b + ₦500) ____ (i)

= 3b + ₦1500

Total number of workers = Total salary

2a + 3b + ₦1500 = ₦9000

If a =b

2a + 3a = ₦9000 - ₦1500

5a = ₦7500

a = ₦7500/5

= ₦1500

:- Each carpenter receives ₦1500 and each bricklayer receives ₦1500 + ₦500 = ₦2000

Step iii Teacher instructed the students to copy note from the chalk board

Step iv: Teacher evaluated by giving the students class and home work

Class work

If a boy is to be paid ₦10 per day for casual work, how many days will he work to collect ₦150?

WEEK 6 LESSON 2 CLAS WORK

Solution

Daily pay of the boy = ₦10

For N130, the boy will work for $\frac{N150}{N10}$ = 15 days

Home work

(1) Find the value of the following when t = 10

(a) t – 18 + t (b) t + 25 – 10

(2) Find the value of the letter in each of the following

(a) $2P = 18 - P$ (b) $r - 2 = 28 - 2r$

(3) ₦30 is to be shared equally among 6 boys. If one of the boys spent 76 kobo out of his own share. How much does he have left?

APPENDIX V

INSTRUCTIONAL GUIDE ON CONVENTIONAL TEACHING STRATEGY (IGCTS)

Week 7

Lesson 1

Topic BASIC ALGEBRAIC OPERATIONS ON TERMS INVOLVING SYMBOLS

Sub topic BODMAS

Objectives: By the time lesson comes to an end, individual students should be able, own their own, to:

i Apply the rules of BODMAS in simplifying simple algebraic expression

Class Jss1

Duration 40 minutes

Step i: Teacher introduces the lesson

Basic algebraic operations involve the use of basic arithmetic operations which are Addition, Multiplication, Subtraction and Division. In simplifying algebraic operations, this abbreviations could be helpful in ordering operations: BODMAS.

B = Bracket

O = Of

D = Division

M = Multiplication

A = Addition

S = Subtraction.

Step i Teacher explains the concept been thought with examples

Example 1: Simplify the following algebraic expressions

(i) 2a + 12b (ii) $\frac{3(a-1)}{4} - {}^{1}/_{2}$(iii) $\frac{a}{4} + \frac{(2a+1)}{3}$

Solution

(i) 2a + 12b = 2 (a + 6b)

(ii) $\frac{3(a-1)}{4} - {}^{1}/_{2} = \frac{3(a-1)-2}{4}$

$= \frac{3a-3-2}{4} = \frac{3a-5}{4}$

(iii) $\frac{a}{4} + \frac{(2a+\ 1)}{3} = \frac{3a+4(2a+1)}{12}$

$= \frac{3a+8a+4}{12}$

= (11a + 4)/12

Step iii Teacher instructed the students to copy note from the chalk board

Step iv: Teacher evaluated by giving the students class and home work

Class work

Simplify (i) 9b – 18 (ii) 2a + 4b + 8

WEEK 7 LESSON 1 CLASS WORK

Solution

(i) 9b – 18 = 9(b-2)

(ii) 2a + 4b + 8 = 2(a + 2b + 4)

Home work

Simplify (i) $\frac{6p}{2q} + \frac{p}{6q}$ (ii) $\frac{x+2}{6} - \frac{2x}{3}$ (iii) 3x – 2y + (6x - y)

APPENDIX V

INSTRUCTIONAL GUIDE ON CONVENTIONAL TEACHING STRATEGY (IGCTS)

Week 7

Lesson 2

Topic	SIMPLE EQUATIONS WITH ONE VARIABLE AND THE USE OF EQUALITY SIGN
Sub topic	SIMPLE EQUATIONS WITH ONE VARIABLE AND THE USE OF EQUALITY SIGN
Objectives:	By the time lesson comes to an end, individual students should be able, own their own, to: i. Solve simple equation with one variable.
Class	Jss1
Duration	40 minutes

Step i: Teacher introduces the lesson

Step ii: Teacher explains the concept been thought with examples

Example1: Find the unknown terms in the following algebraic equations

(i) a + 19 = 28 (ii) $\frac{2x}{4} = 5$ (iii) 2 (x + 1) = 8

Solution

(i) a + 19 = 28

a = 28 – 19

= 9

(ii) $\frac{2x}{4} = 5$

Cross multiply

2x = 5 x 4

2x = 20

Divide both side by 2

$$\frac{2x}{2} = \frac{20}{2}$$

X = 10

(iii) 2 (x + 1) = 8

2x + 2 = 8

2x = 8 – 2

2x = 6

Divide both side by 2

$$\frac{2x}{2} = \frac{6}{2}$$

X = 3

Step iii Teacher instructed the students to copy note from the chalk board

Step iv: Teacher evaluated by giving the students class and home work

Class work

Simplify (i) g – 3 =5 (ii) m + 5 + m = 19

WEEK 7 LESSON 2 CLASS WORK

Solution

(i) g - 3 = 5

Add 3 to both sides

g – 3 + 3 = 5 + 3

g = 8

(ii) m + 5 + m = 19

collect like terms

m + m = 19 – 5

2m = 14

Divide both sides by 2

2m = 14

2 2

m = 7

Home work

Simplify (i) $a/4 = a/6 + 2$ (ii) 2q – 13 = 1

APPENDIX V

INSTRUCTIONAL GUIDE ON CONVENTIONAL TEACHING STRATEGY (IGCTS)

Week 8

Lesson 1

Topic	TRANSLATING WORD SENTENCES INTO SIMPLE EQUATIONS
Sub topic	WORD SENTENCE
Objectives:	By the time lesson comes to an end, individual students should be able, own their own, to: i. Translate word sentences into simple equation and solve same.
Class	Jss1
Duration	40 minutes

Step i. Teacher introduces the lesson

Step ii: Teacher explains the concept been thought with examples

Example 1: A certain number plus 5 gives 9. Find the number (Teacher asks students to read and understand the problem)

Example 1: A certain number plus 5 gives 9. Find the number

Solution

Let the number be y

$y + 5 = 9$

$y = 9 – 5$

$y = 4$

Example 2: Emeka added up his marks leaving behind 6marks due to a mistakes to get 25marks; how many marks had he got at first?

Solution

Let Emeka total marks be K.

K – 6 = 25

K = 25 + 6

K = 31

So Emeka had 31 mark at first

Example 3: The square of a certain number is 16. Find the number.

Solution

Let the number be S

$S^2 = 16$

Take the square root of both sides

$\sqrt{S^2} = \sqrt{16}$

S = 4.

Example 4: The difference between seven times a number and five is sixteen. Find the number

Solution

Let the number be x

$7 \times x - 5 = 16$

$7x - 5 = 16$

Add 5 to both sides

$7x - 5 + 5 = 16 + 5$

$7x = 21$

Divide both sides by 7

$$\frac{7x}{7} = \frac{21}{7}$$

$x = 3$

Step iii Teacher instructed the students to copy note from the chalk board

Step iv: Teacher evaluated by giving the students class and home work

Class work

Seven is subtracted from a number, the result is 9. Find the number.

WEEK 8 CLASS WORK

Solution

Let the number be X

So, $x - 7 = 9$

Collect like terms

$X = 9 + 7$

$X = 16.$

Home work

(1) In a school there are 46 more girls than boys. Altogether there are 380 children. How many boys are there in the school?

(2) Multiply a number by 37 and add 16 to the result, the final result is 1718. What is the number?

APPENDIX VI a

TEACHERS EVALUATION SHEET (TES) FOR INTERACTIVE e-NOTE MATHEMATICS INSTRUCTIONAL STRATEGY (IMIS)

Section A: Demographic Data

(i) School:

(ii) Instructional Strategy used:

(iii) Class:

(iv) No. of students:

(v) No. of period the instructional strategy was used per week:

Please kindly tick (√) an option from E(Excellent), G(Good), P(Poor), VP(Very poor) you feel is appropriate to the following questions

Thank you

Sn	Question	E	G	P	VP
	Section B: Evaluation of instructional Guide				
1	Does the instructional guide have stated objectives on the topics Illustrated?				
2	Is the guide simple and comprehensible?				
3	Were the examples in the guide appropriate for the class in question?				
4	Is the instructional guide user friendly?				
5	Was the guide prepared in line with the national curriculum?				
6	Was the guide consistent on its approach o every topics treated?				
7	Does the strategy encourage students' active class participation?				

Section C: Evaluation of Effective use of Instructional Guide

(a) Presentation of concept

8 Does the guide introduce the concept taught well to the students'?

9 Was the guide explanation of the concepts clear and
Comprehensible to the students'

10 Were the students able to master the concepts well?

11 Were the students' able to answer students' questions posed on the
concepts taught?

(b) Clarity of Topics

12 Did the teacher show mastery of the topics?

13 Was the teacher explanation on all topics clear and well
Understood by the students'?

14 Were the students able to master all topics illustrated by the
guide?

15 Was the teacher able to answer students' questions to clear their doubts?

© Use of instructional Guide

16 Does the students make proper use of instructional guide?

17 Was the guide strictly followed by the students?

18 Does the teacher regularly evaluate the students' progress while using the guide?

19 Does the teacher consistently mark students 'responses to posed questions?

20 Was the teacher able to render necessary assistance to the students?

APPENDIX VI b

TEACHERS EVALUATION SHEET (TES) FOR PROBLEM SOLVING TEACHING STRATEGY (PSS)

Section A: Demographic Data

(i) School:

(ii) Instructional Strategy used:

(iii) Class:

(iv) No. of students:

(v) No. of period the instructional strategy was used per week:

Please kindly tick (√) an option from E(Excellent), G(Good), P(Poor), VP(Very poor) you feel is appropriate to the following questions

Thank you

Sn	Question	E	G	P	VP
	Section B: Evaluation of instructional Guide				
1	Does the instructional guide have stated objectives on the topics Illustrated?				
2	Is the guide simple and comprehensible?				
3	Were the examples in the guide appropriate for the class in question?				
4	Is the instructional guide user friendly?				
5	Was the guide prepared in line with the national curriculum?				
6	Was the guide consistent on its approach o every topics treated?				
7	Does the strategy encourage students' active class participation?				

Section C: Evaluation of Effective use of Instructional Guide

(a) Presentation of concept

8 Does the guide introduce the concept taught well to the students'?

9 Was the guide explanation of the concepts clear and Comprehensible to the students'

10 Were the students able to master the concepts well?

11 Were the students' able to answer students' questions posed on the concepts taught?

(b) Clarity of Topics

12 Did the teacher show mastery of the topics?

13 Was the teacher explanation on all topics clear and well Understood by the students'?

14 Were the students able to master all topics illustrated by the guide?

15 Was the teacher able to answer students' questions to clear their doubts?

© Use of instructional Guide

16 Does the students make proper use of instructional guide?

17 Was the guide strictly followed by the students?

18 Does the teacher regularly evaluate the students' progress while using the guide?

19 Does the teacher consistently mark students 'responses to posed questions?

20 Was the teacher able to render necessary assistance to the students?

APPENDIX VI c

TEACHERS EVALUATION SHEET (TES) FOR CONVENTIONAL TEACHING STRATEGY (CTS)

Section A: Demographic Data

(i) School:

(ii) Instructional Strategy used:

(iii) Class:

(iv) No. of students:

(v) No. of period the instructional strategy was used per week:

Please kindly tick (√) an option from E(Excellent), G(Good), P(Poor), VP(Very poor) you feel is appropriate to the following questions

Thank you

Sn	Question	E	G	P	VP
	Section B: Evaluation of instructional Guide				
1	Does the instructional guide have stated objectives on the topics Illustrated?				
2	Is the guide simple and comprehensible?				
3	Were the examples in the guide appropriate for the class in question?				
4	Is the instructional guide user friendly?				
5	Was the guide prepared in line with the national curriculum?				
6	Was the guide consistent on its approach o every topics treated?				
7	Does the strategy encourage students' active class participation?				

Section C: Evaluation of Effective use of Instructional Guide

(a) Presentation of concept

8 Does the teacher introduce the concept taught well to the students'?

9 Was the teacher explanation of the concepts clear and
Comprehensible to the students'

10 Were the students able to master the concepts well?

11 Was the teacher able to answer students' questions on the
concepts taught?

(b) Mastery of Topics

12 Did the teacher show mastery of the topics?

13 Was the teacher explanation on all topics clear and well
Understood by the students'?

14 Were the students able to master all topics been taught by the
Teacher?

15 Was the teacher able to answer students' questions?

© Use of instructional Guide

16 Does the teacher make proper use of instructional guide?

17 Was the guide strictly followed by the teacher?

18 Does the teacher regularly evaluate the students?

19 Does the teacher consistently mark students 'assessments?

20 Were other example outside the guide used by the teacher
appropriate?

APPENDIX VII

VALIDATION SHEET FOR IMIS

Date: ____

Evaluator: ____

School/Position: ____

Software Title: ____

Subject Area: ____

EVALUATION CHECKLIST

1. CONTENT

a. the subject matter is very relevant

b. the subject matter is good as it is related to educational objectives

c. the face validity of the content is good as it follows appropriate rules of language.

d. Objectives of teaching and learning could be attained through the subject matter

e. the subject matter on the screen is very concise to learners' understanding

f. the subject matter correlates the age of the learners.

g. the subject matter follows the code of conduct, that is, ethics

h. the set of programme represents the world reality

i. The subject matter is set in a way that there is no biasness in term of culture and certain rigid belief of people

j. Objectives of Nigeria education could be met through this content

2. IT IS NOT TOO DIFFICULT TO USE

a. there is concise target

b. there is freedom for the students to leave the programme when they wish to

c. there is possibility for the students to begin from where they stopped initially

d. the programme is simple to use because it is easier for the first timer students make use of the programme

e. it is very easy to locate keys from the menue

f. it is not very hard to print

g. the programme gives each student self-independent on how to handle settings in the programme.

h. the programme make necessary educational material accessible

i. learners can easily look at the require or appropriate instruction from directly the screen
j. it is not so difficulty to do a lot of different things via the programme
k. installation cannot pose challenges to the programme users
l. There is no system error interference when students are using the programme because the software of programme is dependable or reliable.
m. The software makes it easier for the students to know when they have committed mistakes

3. ABILITY LEVELS

a. teacher can regulate the students level
b. both the guidelines and students reading ability are all appropriate to the users levels and this means that the programme is sequence in nature.
c. the previous knowledge and the age of the users are also considered in the progromme
d. The programme is set in a way that the level of the students is progressive in nature and it is automatic progression
e. Diverse students' ability stages are all included in the software package

4. ENGAGEMENT/INTERACTIVITY

a. The software allows students enagement in the programme and it also gives timely reply to the students.
b. The programme is motivating in nature because it enables its users wishing to learn diverse concepts more
c. The programme design is good in consistence manner and also follows logicality.
d. The guidelines that imbedded in the screen is not difficult.
e. The rate at which programme to be used is being direct by separate distinct menu such as exit, pause and stop.

5. ASSESSMENT

a. mode of evaluating and feedback have been programmed in the software
b. the appropriate information as regard students' progress is included in the software programme.
c. the reply the students get from the software are to enhance students learning and not to demotivating them
d. there is correlation between mode of evaluation and stipulated objectives of learning.

e. students' advancement in learning are included in the software package and as well of their records.
f. Teacher can know the students achievement by checking records relating to their progress.
6. TECHNICAL QUALITY
a. The software are designed to efficiently make use of animation and graphics
b. Media involve are of good standard that can enhance learning.
c. The programme relating to text and background are friendly and it is not so hard to read meaning to.
d. Anybody from and race make make use of the image and text in the programme
e. The students have access to save their work at a regular interval either to local drive or network.
f. Students who are still working on the programme can be saving as well because such option is available.
g. Printing/downloading/export/importcapabilitiesworkproperly.
h. There is quality of audio in both input and output voices
i. The rate of instant reply of feedback is highly commendable
j. The programme is designed in such a way that branching is possible
k. The programme function in such a way that once a key is pressed there will be an input occurrence
7. FUN
a. Any time the users make use of the programme it is always interesting
b. It covers diver mode of learning style preferences and as well as different age group.
c. Each situation occurs by chance and it never comes again once it appears with a particular usage

8. ADAPTABILITY
a. Any programme that requires installation can go in line with this software.
b. This set of programme is compatible withoperatingsystems.
c. There is an integration ofadaptive and assistivetechnologies in the programme.
1 strongly disagree
2 disagree

3 agree

4 strongly agree

NA- Not applicable

Check the rating for each items

S/N	**ITEM**	1	2	3	4	
A	**CONTENT**					
1	The content is accurate and factual					
2	The content is educationally appropriate					
3	The content is free of errors in grammar, spelling and punctuation.					
4	The content meets learning goals and objectives					
5	Screen content contains nothing that would confuse the learner					
6	The content is age appropriate					
7	Content is bias-free, or illustrates a sense of moral and ethical issues					
8	Program is an accurate depiction of the real world					
9	The content is free of stereotypes and cultural bias					
10	The content meets the Nigerian basic education standards					
B	**EASE OF USE**					
11	Directions are clear					
12	Students can exit the program at any time					
13	Students can restart the program where they stopped					
14	Students can use program independently on the first try					
15	Keys, menus and icons are accessible and intuitive					
16	Printing is simple					
17	Learner has some control over settings and experiences of					

	program					
18	Additional materials (textbook, teacher guide, etc.) are available					
19	Instructions can be viewed onscreen					
20	Easy to manipulate through the program					
21	Easy to install					
22	The software is reliable and free of disruption by system errors					
23	Learner knows if error has been made					
C	**ABILITY LEVELS**					
34	The user level can be set by the teacher					
35	Thereadinglevelissuitableforthetargetaudience;direction sareunderstandabletousers.Skillsprogresslogically					
36	Appropriate teaching strategy, experiences and readability for age level					
37	The user level automatically advances					
38	The software covers a variety of ability/skill levels					
D	**ENGAGEMENT/INTERACTIVITY**					
39	Learnersareactivelyengagedandreceivetimelyfeedback.					
40	Usersaremotivatedtocontinuelearningandtomasterconce pts					
41	Layoutislogical,intuitive,andconsistent.					
42	Screendirectionsareeasytofollow.					
43	Paceiscontrollablewithoptionsforstop/pause/exit.					
E	**ASSESSMENT**					
44	Software has built in assessment and reporting tools					

45	Theprogramprovidesmeaningfulindividualstudentandgroupdata,trackingprogresstowardobjectives					
46	Feedback reinforces content and is not abusive or insulting					
47	Assessment methods are appropriate and suited to learning objectives					
48	Software documents and records student's progress					
49	Teachers easily can assess student' progress by evaluating progress reports					
F	**TECHNICAL QUALITY**					
50	Animation and graphics are used well					
51	Graphics,audio,video,andmusicareofhighqualityandoptimizelearning.					
52	Backgroundandtextarecompatibleandeasytoread.					
53	Thetextandimagesaregenderfairandfreeofracial,ethnic,andculturalbiasesorstereotypes					
54	Userscansaveatregularintervalstonetworkorlocaldrive.					
55	Saveoptionisavailableforactivitiesinprogress.					
56	Printing/downloading/export/importcapabilitiesworkproperly.					
57	Audio(voice input/output) is used well					
58	Feedback and prompts are appropriate					
59	The application allows branching					
60	If a key is pounded or held down only one input occurs					
G	**FUN**					
61	Makes learning fun, meaningful and interesting with every use					

62	Captivates a range of learning styles and broad age groups					
63	Events are randomly generated and not repeated with each use					
H	**ADAPTABILITY**					
64	Softwareiscompatiblewithotherinstalledprograms.					
65	Programworksondistrictplatformsandoperatingsystems.					
66	Theprogramincorporatesfeaturesthatsupportadaptive/assistivetechnologies.					

APPENDIX VIII

RUBRIC FOR THE VALIDATION OF IMIS PACKAGE

	Poor 1 pts	Fair 2 pts	Good 3 pts	Excellent 4 pts	Comments

					(N/A)
Curriculum Content	Poor No relationship with curriculum content exists. Content does not meet goals or standards	Fair Limited relationship with curriculum content. Content meets few goals or standards.	Good Good relationship with curriculum content. Content meets some goals and standards.	Excellent Direct relationship with curriculum content. Content meets most to all goals and standards.	Comm ents
Interactivit y	Poor Lacks enhancements to actively involve the learner.	Fair Minimal enhancements to actively involve the learner.	Good Contains some enhancements to actively involve the learner.	Excellent Possess many enhancement s that require learner to remain actively involved.	Comm ents
Critical Thinking	Poor Student not given opportunity to engage in	Fair Student given limited opportunities to engage in higher	Good Student given some opportunity to engage in	Excellent Student given extensive opportunities	Comm ents

	higher level thinking.	level thinking.	higher level thinking.	to engage in higher level thinking activities.	
Classroom Environment	Poor	Fair	Good	Excellent	Comments
	No clear use of the software in regular classroom activities.	Few lessons can be used in the classroom setting and there are few suggestions for use of the material for whole class, individual or group lessons.	Software can be integrated in classroom activities and there are suggested uses for whole class, individual and group lessons.	All features can be used in classroom activities and the material includes activities for whole class, individual and group lessons.	
Accessibility	Poor	Fair	Good	Excellent	Comments
	Graphics/links are not labeled or don't offer rollover labeling, fonts are difficult to read and content does	Graphics/links are seldom labelled or seldom offer rollover labeling, fonts are sometimes used for ease of student reading and some	Graphics/links are mostly labeled or have rollover labeling, fonts are mostly easy to read and most	Graphics/links are labeled or have rollover labeling, fonts are consistently easy to read	

	not lend itself to varied learning styles and ability levels.	content is accommodating to varied learning styles and ability levels.	content supports varied learning styles and ability levels.	and varied learning styles and ability levels are accommodated.	
Age/Grade Level	Poor Directions, reading level, and product are inappropriate for targeted audience.	Fair Directions, reading level, and product are are sometimes inappropriate for targeted audience.	Good Directions, reading level, and product are are mostly appropriate for targeted audience.	Excellent Directions, reading level and product are appropriate for targeted audience.	Comments
Effectiveness of Software	Poor Design is confusing and is not navigable. The technology does not provide any benefit.	Fair Design lacks intuition and is difficult to navigate. Minimal effectiveness.	Good Design is clear, but assistance is needed to navigate some areas. Technology is adequately utilized to be of benefit in the	Excellent Design is clear, easy to navigate, logical and provides an effective means to help students achieve.	Comments

			instructional process.		
Assessment Component	Poor Assessment is unrelated or not available.	Fair Assessment does not engage learner and additional assessment is required.	Good Assessment is usually appropriate and can provide some measure of what has been learned.	Excellent Assessment is suited to goals and student ability and easily assesses what has been learned.	Comm ents
Teacher Accessibility	Poor Software allows the teacher limited to no access to the monitoring of activities, assignments, assessments, and grades	Fair Software allows the teacher moderate access to whole group monitoring of activities, assignments, assessments, and grades	Good Software allows the teacher full access to whole group monitoring of activities, assignments, assessments, and grades	Excellent Software allows the teacher full access to individual student monitoring of activities, assignments, assessments, and grades	Comm ents
Effectiveness in teaching	Poor Software is	Fair Software is	Good Software is	Excellent Software is	Comm ents

	ineffective in teaching desired content. Interactivity is unrelated to learning, not directed at student enjoyment.	partially effective in teaching desired content, with limited interactivity and appeal to students.	mostly effective in teaching desired content, with some interactivity that appeals to students.	effective in teaching the desired content in an interactive way that students will enjoy while learning.	
Speed	Poor Students advance at a much too slow or too fast pace. Speed is not based on individual needs	Fair Students advance at a slightly slow or fast rate. All students advance at the same speed.	Good Students advance at a moderate rate. Most students advance at the same speed.	Excellent Students advance at a speed that is appropriate to their individual learning needs	Comments

APPENDIX IX

ANSWER TO MATHEMATICS ACHIEVEMENT TEST (MAT)

1.	C	11	D	21.	B

2.	A	12.	C	22.	D
3.	D	13.	B	23.	A
4.	B	14	D	24.	D
5.	D	15.	B	25.	C
6.	A	16.	A	26.	A
7.	C	17.	A	27.	C
8.	D	18.	C	28.	A
9.	B	19.	B	29.	D
10.	A	20.	C	30.	B