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INTERACTIVE E-NOTE AND PROBLEM-SOLVING STRATEGIES: THEIR EFFECTS ON JUNIOR SECONDARY SCHOOL STUDENTS'ATTITUDE TO MATHEMATICS IN KADUNA, NIGERIA

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ABSTRACT

Mathematics aids the development of science and technology, but many secondary school students perform poorly in it in public examinations in Kaduna State, Nigeria due to the use of ineffective instructional strategies by teachers. Hence experts advocates the need to complement mathematics teaching with tools that could engage learners in active learning. Previous studies neglected Interactive e-note Mathematics Instructional Strategy (IMIS) and Problem-Solving Strategy (PSS) capable of enhancing students 'attitude to mathematics in junior secondary schools as determined by this study. 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 LGAs on co-educational basis and geographical locations Schools were randomly assigned to IMIS (134), PSS (134) and control (132) groups. Treatment lasted 12 weeks. Instrumentation are 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. 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' attitude mean score are IMIS (105.39), PSS (100.35) and control (97.51). School type had significant main effects on students attitude to mathematics ($F_{(1,385)}$=15.73; partial η^2=0.04) from private schools. Treatment and school type had significant interaction effect on students' attitude to mathematics ($F_{(2,385)}$=5.9; partial η^2=0.03) from private school in IMIS group. Interactive e-note and problem-solving instructional strategies enhanced students' attitude to mathematics in Kaduna, Nigeria so should be adopted in public secondary junior schools.

Keywords: *Interactive e-note strategy, Problem-solving strategy, Students' attitude to mathematics, Junior, Secondary*

INTRODUCTION

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.

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).

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 Evaluation Standards 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 et al (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 to Craig (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

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.

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' 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 effects of Interactive e-note instructional strategy and Problem-solving strategy on junior secondary school attitude to Mathematics in Kaduna, Nigeria, while the moderating effect of school type and gender were also examined.

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' attitude to Mathematics

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

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

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

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

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

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

METHODOLOGY

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)

Population: A total of 400 Js (1) students selected from three private and three public schools within two purposively selected local government areas in Kaduna State took part in the study

Research Instruments

The following research instruments were used in the study
1. Student Attitude towards Mathematics Questionnaire (SAMQ)
2. Interactive e-note Mathematics Instruction Strategy (IMIS)
3. Instructional Guide for Problem Solving Strategy (IGPSS)
4. Instructional Guide for Conventional Teaching Strategy (IGCTS)
5. 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)

Data Collection

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 notified that they are

been used for the study. The administration of pretest (Students Attitude towards Mathematics Questionnaire) then followed. JS1 Mathematics teachers from each of the six schools were given training in the use of strategies appropriate for their group for two weeks. From the two local government selected for this study, one private and one public schools was 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. At the end of the instruction, the pretest instruments were used as posttest to all groups. The experiment covers a total of 12 weeks.

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

RESULT AND DISCUSSION

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

Presentation of Results

Hypothesis 1: 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 * Gender	86 .759	2	43.380	1.337	.264	.007
Error	12490.760	385	32.444			
Total	4144937.000	398				
Corrected Total	41392.857	397				

R Squared =.698 (Adjusted R squared =.689). *depict significant at 0.05 level of significance

Source: Field Sturdy, 2019

Table 1 shows that the treatment had a significant main effect on students' attitude towards Mathematics ($F_{(2,385)} = 65.45; p < 0.05; \eta^2 = 0.254$).. Therefore, the null hypothesis 1 is rejected. This implies that the treatment had a significant main effect on students' attitude to Mathematics with an effect size of 25.4%. 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 scores of the treatment groups.

Table 2 Estimated Marginal Means

Post Attitude				
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.

Source: Field Sturdy, 2019

Table 2 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 to problem-solving instructional strategy ($\bar{x} = 100.35$) and the least posttest mean attitude score was obtained by those exposed to the conventional instructional strategy ($\bar{x} = 97.51$).

Table3 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

Problem Solving - CIS	Interactive e-note	-5.036*	.747	.000	-6.709	-4.639
	CIS	2.842*	.708	.000	1.045	6.175
	Interactive e-note	-7.878*	.747	.000	-9.581	-1.045
	Problem Solving	-2.842*			-4.639	

Source: Field Sturdy, 2019
Based on estimated marginal means
*. The mean difference is significant at the .05 level.
b. Adjustment for multiple comparisons: Bonferroni.

Table 3 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 3 that revealed a significant main effect of treatment on students' attitude which was due to the posttest attitude mean score of students exposed to interactive e-note and problem solving instructional strategies respectively. This is further expressed in the estimated marginal mean computed in Table 2

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

Table 1 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 2 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 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.

Source: Field Sturdy, 2019

Table 4 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 3: There is no significant main effect of gender on student' attitude to Mathematics

Table 1 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 3 is not rejected. This implies that there is no significant main effect of gender on students' attitude to Mathematics.

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

Table 1 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 4 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 5

Table 5 Estimated Marginal means of Post Attitude Treatment by School type

	School type	Mean	Std. Error	95% Confidence Interval	
				Lower Bound	Upper Bound
	Public	103.071[a]	.641	101.810	104.332

Interactive e-note	Private	107.698[a]	.648	106.425	108.971
	Public	100.446[a]	.748	98.975	101.917
Problem Solving	Private	100.250[a]	.740	98.796	101.705
	Public	96.264[a]	.766	94.759	97.770
CIS	Private	98.749[a]	.742	97.291	100.207

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

Source: Field Sturdy, 2019

Table 5 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

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

The result in Table 1 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 5 is not rejected. This implies that the interaction effect of treatment and gender on students' attitudes towards Mathematics is not significant.

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

The result in Table 1 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 6 is not rejected. This implies that the interaction effect of school type and gender on students' achievement in Mathematics is not significant.

Hypothesis7: There is no significant interaction effect of treatment, school type and gender on student' attitude to Mathematics

The result in Table 1 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 7 is not rejected. This implies that the interaction effect of treatment, school type and gender on students' attitude to Mathematics is not significant

Discussion of Findings

Main Effect of Treatment on Attitude to Mathematics

The findings of this study showed that the main effect of treatment on students 'attitude shows that 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.

Main Effect of School Types on Attitude to Mathematics

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.

Main Effect of Gender on Attitude to Mathematics

The findings of this study is 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

Interaction Effect of Treatment and School Type on Attitude to Mathematics

From the finding of this study it can be 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.

Interaction Effect of Treatment and gender on Attitude to Mathematics

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' achievement irrespective of the method of teaching in Mathematics.

Interaction Effect of School type and gender on Attitude to Mathematics

The result 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.

Interaction Effect of Treatment, School type Attitude to Mathematics

The result 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

Conclusion

Based on the discussion above, we thus conclude that students attitude towards mathematics could be greatly enhanced with the use of technology in the mathematics classroom as portrayed by the findings of this research. Furthermore adequate knowledge of problem-solving technique also develop and improve students' attitudes towards mathematics learning significantly.

Recommendation

We hereby recommends that interactive e-note and problem-solving strategies should be adopted in teaching mathematics in both junior and senior secondary schools in Nigeria to promote positive attitudes of students in learning the subject.

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