EFFECTS OF ENGLISH LANGUAGE ON STUDENTS’ PERFORMANCE IN TEACHING AND LEARNING OF MATHEMATICAL MODELLING AT JUNIOR SECONDARY SCHOOL LEVEL IN BAUCHI STATE, NIGERIA

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E83F/28974/2013

A Thesis Submitted in Fulfillment of the Requirements for the Degree of Doctor of Philosophy in the Department of Educational Communication and Technology, School of Education, Kenyatta University, Kenya

November, 2016
DECLARATION

I confirm that this research thesis is my original work and has not been presented in any other university/institution. The thesis has been complemented by referenced works duly acknowledged. Where text, data, graphics, pictures or tables have been borrowed from other works including the internet, the sources are specifically accredited through referencing in accordance with anti-plagiarism regulations.

Signature ……………………… Date…………………………

Dogo, Peter (E83 F/28974/2013)

We confirm that the report in this thesis was carried out by the candidate under our supervision

Signature……………………………… Date…………………………

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Department of Educational Communication and Technology

Kenyatta University

Signature ………………………………… Date ……………………..

Prof. Samson Rosana Ondigi

Department of Educational Communication and Technology

Kenyatta University
DEDICATION

To God, all honor and majesty belong. He directed my late father (Mr. Sahuna Kyawu) together with my mum (Mrs.Naomi S. Kyawu) and my late wife (Mrs. Veronica Peter. Dogo) to lay a foundation for me in this academic pursuit. They started the journey with me but could not reach the destination. However, they blessed and wished me well in realizing this noble and scholarly work. This is marvelous and gracious. I say it again; all honor and majesty belong to God through our Lord Jesus Christ.
AKNOWLEDGEMENTS

I wish to extend my appreciation to Dr. Miheso, M.K. O'Connor and Prof. S. R. Ondigi for their support and encouragement from the beginning to the end of this research work. I also want to extend my appreciation to Justice B.G. Sanga, Prof. H. Ayot, Prof. I.M. Danjuma, Dr. S.M. Ndethiu (My Chairperson), Dr. Aminu Yakubu, Dr. Napoleon Daniel Usman, Dr. Catherine Omole, Malam Mustapha Danjuma (My Dean, SST) for their good courage and support. I also thank all academic and non-academic members of Educational Communication and Technology for their good courage and support showed to me.

I wish to extend my appreciation to the Bauchi State Government, the Management of the Abubakar Tatari Ali Polytechnic, Bauchi who ensured that I did not face any difficulty in my study. This was done and achieved through the Tertiary Educational Trust Fund (TETFUND) support. My beautiful wife (Mrs. Rahila Peter Dogo) and my children are never left behind. They really stood by me, giving me support and prayed for me. Thank you for the good work. I also would not forget the effort of all my friends who stood by me in doing this scholarly work. Thank once more. Mr. Anthony D. Bojana deserves gratitude for editing the final work.

Finally my Uncles; Ali Kyawu, on behalf of others, my immediate brothers; Surveyor Itatu Barde, on behalf of my brothers and sisters. You have really occupied the position of my late father (Sahuna Kyawu) to see that my dreams are achieved. Thank you all.
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# ABBREVIATIONS AND ACRONYMS

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<th>Description</th>
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<tbody>
<tr>
<td>AME</td>
<td>Association for Computational Mechanics in Engineering</td>
</tr>
<tr>
<td>ANOVA</td>
<td>Analysis of Variance</td>
</tr>
<tr>
<td>BICS</td>
<td>Basic Interpersonal Communicative Skills</td>
</tr>
<tr>
<td>CALP</td>
<td>Cognitive Academic Language Proficiency</td>
</tr>
<tr>
<td>CLS</td>
<td>Concept Learning Strategy</td>
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<tr>
<td>CCSSM</td>
<td>Common Core State Standards</td>
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<tr>
<td>ELLs</td>
<td>English Language For Learners</td>
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<tr>
<td>FMoE</td>
<td>Federal Ministry of Education</td>
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<tr>
<td>JSSCE</td>
<td>Junior Secondary School Certificate Examination</td>
</tr>
<tr>
<td>JSSMC</td>
<td>Junior Secondary School Mathematics Curriculum</td>
</tr>
<tr>
<td>JSS</td>
<td>Junior Secondary Students</td>
</tr>
<tr>
<td>JSSMS</td>
<td>Junior Secondary School Mathematics Syllabus</td>
</tr>
<tr>
<td>KCPE</td>
<td>Kenya Certificate of Primary Education</td>
</tr>
<tr>
<td>KSCE</td>
<td>Kenya Secondary Certificate Examination</td>
</tr>
<tr>
<td>LEA</td>
<td>Local Education Authority</td>
</tr>
<tr>
<td>LEP</td>
<td>Limited English Proficiency</td>
</tr>
<tr>
<td>MMA</td>
<td>Mathematical Modelling Approach</td>
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</table>
MTQ  Mathematics Teacher Questionnaires

MWPST  Mathematics Word Problem Solving Test

MoE  Ministry of Education

NCRESST  National Center for Research on Evaluation, Standards, and Student Testing

NERDC  Nigerian Educational and Research Development Council

NCTM  National Council of Teachers of Mathematics

NCCCA  National Council for Curriculum and Assessment

NGM  New General Mathematics

NPC  National Population Commission

NPE  National Policy on Education

NRC  National Research Council

PCK  Pedagogical Content Knowledge

PLS  Procedural Learning Strategy

PISA  Programme for International Students Association

PSSSM  Principles and Standard for Schools Mathematics

STM  Science, Technology and Mathematics
<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
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<tbody>
<tr>
<td>SSCE</td>
<td>Senior Secondary Certificate Examination</td>
</tr>
<tr>
<td>TETFUND</td>
<td>Tertiary Educational Trust Fund</td>
</tr>
<tr>
<td>TIMSS</td>
<td>Trends in International Mathematics and Science Study</td>
</tr>
<tr>
<td>WAEC</td>
<td>West African Examination Council</td>
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ABSTRACT

English as a language of instruction is recommended in the Nigerian mathematics classroom, it is also a second language where both teachers and students necessarily use at home to communicate. The study aimed at establishing the effect of English as a second language in teaching and learning of mathematical modelling at junior secondary school level in Nigeria. The junior secondary two learners in Nigeria are second language students who learn mathematics and particularly word problems in multilingual classrooms. Specifically, the research was to; establish teachers’ proficiency level of English as a medium of instruction in mathematics classroom, establish teachers’ preparedness as they teach word problems in English, determine the effect of English Language on teaching and learning of mathematical modelling (word problems) with regard to students’ performance, determine the effect of mathematical modelling on gender performance and developed mathematical modelling approach for mathematics junior secondary school teachers in Nigeria. The Solomon Four Group design was used as a research design for the study. The design used data obtained from both the pre-test and post-test in the four groups. The instruments used for data collection in this study were interviews, Mathematics Teacher Questionnaires (MTQ), Students’ Achievements Test (MWPST) and the classroom observations. The total sampled of the population used in the was 430 (number of teachers 10 and number of students 410). The study used non-proportional and purposeful sampling techniques in chosen the sample. Data from the research instruments were coded and analyzed using Statistical Package for Social Sciences (SPSS) version 17. Analysis of Variance (ANOVA) and independent t-test were used to test hypotheses at 0.05 level of significance. Analysis of data generated from students pre-test revealed that, the effect of English on students’ performance in word problems was insignificant (t (203) =0.919, p>0.05). This revealed that students’ performance was the same before the commencement of the treatment. Post-test result from the study on the effect of English language on students’ performance indicated a significant difference (F(402)=48.63, p=0.01, p<0.05).This implies that intervention strategy (Mathematical Modelling) has significantly improved the performance and problem solving abilities of those groups who were given treatment (experimental) in word problems more than those who were not given the treatment (control). Results of the post-test mean score between the treatment (experimental groups) and controlled groups show a significant difference (p < .05). The data also suggest that the intervention strategy (mathematical modelling) in the posttest positively influenced gender performance and shows a significance difference (t (108) =13.16, p >0.05) in word problem-solving abilities. This implies that gender performance in the post-test was not similar but an increased their performance. Overall results in this study illustrate that number skills displayed by learners seem to be directly related to language use in the classroom.
**Key words:** Language, Second language, English language Proficiency, Modelling, Mathematical problem solving, Real word problems, students.
CHAPTER ONE

INTRODUCTION

This research describes the way algebraic word problems are taught in Nigerian schools, and the effects of English language as a medium of instruction in the mathematics classroom at the lower secondary schools in their second year. The chapter focused on the background to the study, statement of the problem, purpose of the study, research questions and research hypotheses, significance of the study, limitation and delimitation, assumptions, theoretical and conceptual framework and operational definition of terms.

1.1 Background to the Study

Learning of mathematics develops good knowledge and understanding because of its application to all fields of human endeavor. It is a field of study that brings about logical thinking and reasoning toward a solution to problem that is to be solved. Gouba (2008) viewed mathematics as a peculiar subject that is recognized in the entire world. It is, therefore, integrated in education so as to prepare students with the basic requirement necessary for proceeding to higher education, career aspirations and for personnel living. It remains as the base for all sciences and technologies in the world (Uchechi, 2013).

Gambari, et al., (2013) viewed mathematics as the subject that takes a significant position in developing the individual knowledge and plays a significant role in enhancing the country’s socio-economic development. It is a means of social functions in our day-to-day activities. The social functions include: buying,
selling, and banking, among others. Association for Computational Mechanics in Engineering (ACME, 2011) agreed that mathematics makes an essential contribution to a good rounded education, playing a vital role in the area industry and technology. Without a sound understanding of mathematics appreciation of a range of other educational disciplines such as music, the sciences, geography and economics is compromised (Vorderman et al., 2011). Welberry (2009) viewed that mathematics defines a situation and gives the reason for the existence of the problem situation. In essence therefore it develops knowledge and understanding which can be applied to solve relevant problems or situations.

The study of mathematics leads to good and logical thinking, accuracy and creativity. Mathematics is an essential tool in the exploration of our world and viewed as the science of understanding patterns that exist around us and solving problems in our daily life (Agwu, 2015). Mathematics deals with nature and refers to that aspect of numbers which may be found in sand dunes and the aspect of movement which may include how an individual person walks, talks, and reasons and this explains why mathematics helps us to understand and control our nature (NCCA, 2014). NCTM (2006) recommended that students at lower level of education need to learn mathematics to excel at higher levels of generalization of models and solve complex problems. This would provide the opportunity for many countries of the world to remain competitive in terms of economy that is needed for scientific and technological development.
National Council of Teachers of Mathematics (NCTM, 2012) maintained that every student should have equitable and optimal opportunities to learn mathematics free from bias – intentional or unintentional- based on race, gender, socioeconomic status, or language. To close the achievement gap, all students need the opportunity to learn challenging mathematics from a well-qualified teacher who will make connections to the background, needs, and cultures of all learners (NCTM, 2012). We must communicate to learn languages and mathematics. Focus on mathematical representations, mathematics language syntax, grammar, and semantics are flexible in English language.

Percy & Andrew (2014) opines that translation from words to symbols is undeniably one of the solution processes in solving word problems, examples of such words or phrases which are English groups and can be translated into mathematical symbols, may include sum (+), difference (-), take away (-), of (x) product (x), ago (-) division (÷), less than (<), greater than (>), etc. Symbols in brackets after each word stated are refers to as mathematical symbols or notation. The challenge on learners would then be to relearn these familiar words and assimilate them into correct mathematical contexts. This challenge therefore can only be addressed when leaners have the required proficiency of both the text language and the language of instruction.

Further research indicated that for learners to be successful in mathematics, it requires teachers to have a deep knowledge of both the language of instruction and the subject matter which they are expected to teach (Ball, Thames & Phelps
A clear view of how student is learning mathematics develops and progresses across levels (Daro, Mosher & Corcoran 2011). It also requires teachers to be skilled at teaching in ways that are effective in developing mathematics learning for all students. Mathematics learning should focus on developing understanding of concepts and procedures through problem solving, reasoning, and discourse (NCTM, 2012). Students’ understanding is deepened when both the language of instruction and the method used by teachers provide the discussion of similarities among representations that revealed underlying mathematical structures or essential features of mathematical ideas (Zimba 2011).

Kenya, one of the African countries is set to achieve Vision 2030, whose aim is making Kenya a newly industrialized middle income country, thus student population must excel in sciences, and the vehicle for this is mathematics (Githua & Njoroge, 2013). Thus students who acquire knowledge of mathematics are likely to excel in science, engineering and technical subjects and this knowledge of mathematics remain as a base for equipping young learners with scientific and technological skills. Despite the need for young learners to excel in mathematics, students’ performance in mathematics in Kenya has consistently been ranked last in performance in comparison with the other subjects offered at the KCSE (KNEC, 2008). A critical look at the students’ overall performance in mathematics at the KCSE from the year 2002 to 2008 national examinations revealed that the students’ performance persistently remained low. Ogeche (2009) in related study concerning the importance of the second language in Kenyan
secondary level of education, found that all learners at this level of education will communicate in the language they used in learning mathematics and this would enable them to express themselves fully when learning mathematics. The students’ proficiency in mathematics language instruction becomes necessary, if students are to excel and perform well in mathematics.

Mbuaga et al., (2012) in their study on factors contributing to students’ poor performance in Mathematics at Kenya Certificate of Secondary Education revealed that factors may include teachers strategies, students economic background, proficiency of the language of instruction by students. Benson and O’Oconnor (2015) found that students poor performance at the national examination (KSCE) would be as a result of their in ability to comprehend mathematics vocabulary and the language of instruction. For students to excel, they must recognize, comprehend and apply the requisite mathematical vocabulary.

In Singapore, the necessity to study mathematics has led to the revisions of its mathematics curriculum in order to meet the requirement that align with international reform movements (SMoE, 2007, p.14). The curriculum framework is aimed at equipping learners to become effective and good problem solvers, it is based on five important aspect of human learning, these include; the inculcation of skills, knowledge, behaviors, metacognition and mental process(Eric, 2009). The Good reason for the introduction of new mathematics curriculum is seen as an important step for which learners will develop problem-
solving abilities and see problem-solving more relevant and effective. It will also enable leaners to have the required ability for advanced mathematics.

In South Africa, despite wide spread acceptance of the notion that improving performance of students in mathematics may have a high economic and sound payoff, analyse in all countries have surprisingly little information on which to base educational strategies. Student’s low performances at lower level exams in mathematics and English language in the country have become a matter of concern when compared to other African countries that participated in the exams (Van den & Damme, 2001). Some challenges in South Africa is the quality of education, that is to say, that many teachers in the country are not teaching their subject as required and there are large number of teachers who are teaching mathematics that are not qualified and that bring about students poor performance in the subject.

Sarah (2003) in her study on language and other background factors affecting secondary pupils’ performance in Mathematics in South Africa considers language background as a factor that affects students’ performance in mathematics in South African secondary schools. 8000 South African students in 200 different schools were tested in mathematics and science as well as English which was a national option.. The results of the test were substantially low including other developing countries like Morocco, Chile, Indonesia and Philippines. The study confirms that proficiency in English language does correlate with their achievement in mathematics; students with high scores in
mathematics also performed well in the English test administered while those with low scores didn’t perform.

In Malaysia, students’ performances at secondary level of education remain very low. Mathematics achievement test in TIMSS in 2003 clearly indicates how well students in Singapore have done. Over 50 percent of them achieved more than the average score of 603 compared to Malaysian students with only 10% (Mullis et al., 2004). The poor performance of the students becomes a major concern among Malaysian educational stakeholders. This brings about the need for language policy for teaching mathematics and science in English, this was introduced at all levels of education in the year 2003 (IRC, 2008). This policy was then commenced and takes up properly after a period of five years in the level of education.

The motives for the use of English as a medium of instruction was to enable leaners to have the knowledge of medium of instruction so that knowledge or skills are acquired through this medium of instruction to be assessable for both public and private employment. Another reason was that, the students’ performance from public secondary achievement test revealed poor knowledge or understanding of language of instruction among learners, since for the past decades at least forty six per cent (46%) of learners failed to acquire the required level of performance in English in the basic level of examination (Sua, 2007).
Another reflection of students low performance in mathematics was that of the United State of America (USA) where the US group (students) of 2009 who were taught and covered most topics in mathematics was lower than that of most countries that participated in the Program for International Students Association (PISA) in mathematics test. The US had majority of participants who sat for the test and only eight percentage (8%) of the US student scored the test when compared to Taiwanese students where twenty eight percent (28%) of her students who scored the test, twenty percent (20%) of these students in Honkong, Korea, and England were highly accomplished and the remain percentage goes to other countries that participated in the test (OECD, 2010). In a related study in the US, Abedi (2001) found that proficiency in the language of instruction determines students’ performance in mathematics. In his analysis he found that students’ performance in teacher-made test may be related with level of understanding the language of instruction. In this regard, those who have high proficiency in the language of instruction performed better than those with low level of proficiency in English in learning mathematics.

In Cyprus, students’ level of performance in mathematics at the 6th grade (11 years) becomes a major concern. Mousoulides, Pittalis & Chiston (2006) in their studies on enhancing students’ performance through developing models at primary and secondary levels of education in Cyprus viewed that, developing relevant equations when teaching word problems, students are likely to conceptualize the meaning of the existing problem and used relevant equation to
solve related problems. Students’ ability to form relevant equations through modelling procedures will greatly enhance their performance and problem solving ability as well as their proficiency of the text language.

In Nigeria, good performance in mathematics and English is one of the basic requirements for admission into tertiary institutions (Adeyemi, 2011). Candidates with distinction (A1 to B3) and credit grades (C4 to C6) in five subjects including Mathematics and English language possess the requisite grades for admissions into Nigerian universities (JAMB, 2007). Emaikwu (2012) in his research ‘Effectiveness of three teaching methods in the measurement of students’ performance in Mathematics in Nigerian secondary schools’ viewed that there has been drastic reduction in the achievement level of leaners in mathematics for the past decades.

Uchechi (2013) submitted that students’ poor performance in Mathematics in Nigerian public examinations is traceable to lack of content coverage and poor teaching methods by teachers. The resultant effect is the poor performance and low retention level in leaners achievement at the national and international examinations. In view of this, therefore there is a serious and great concern among the educational stakeholders, parents and general public about the language policy and methods that are good and relevant in mathematics classroom all over the world and Nigeria secondary schools in particular. Since goals and aims of teaching mathematics as a subject are geared toward improving and
sustaining economy globally, the language in learning the subject should be acceptable all over the world (Fajemigba, 1991).

In Nigeria the language instruction in learning mathematics at secondary level of education is English language (NPE, 2004). David (2011) in his research on the language teaching policy in Nigeria viewed that for a period of time, several efforts are being made to renewed interest in the area of mathematics using the three main indigenous language in Nigeria (Hausa, Igbo, and Yoruba), to provide understanding of the language of instruction in Nigeria. There is no doubt that we have multiplicity of languages among different ethnic groups in Nigeria with each group guarding its language jealously, yet there has not been a separate language policy in the mathematics classroom at both junior and senior secondary levels of education. In essence therefore, the National Policy in Education recommends that education is free and compulsory for all children form primary to secondary level, therefore, the teaching of science and mathematics in English language at junior and senior secondary school level of education in Nigeria is recommended (NPE, 2004: 11, & NPE, 2013).

The influence of English proficiency on Nigerian secondary school students’ performance therefore cannot be overlooked. Adeyemi & Adeyemi (2012) in their study on the importance of the knowledge of language of instruction on junior secondary school students performance in school subjects in Nigeria viewed that, the government, in recognizing the importance of the language (English),
enacted a language policy and documented this in the National Policy on Education.

In a related study, Adeg oke (2010) found that students' performance in mathematics may not be related to their level of understanding the language of instruction, but that the method and the way content are being presented can also determine their level of performance in the subject. More importantly students who are very fluent and proficient in English language may understand and solve some mathematical concepts. In an experimental study, Adeg oke (2010) found that among the Yoruba people in Nigeria, learners with high level of understanding the language of instruction performed significantly better in mathematics compared to those who have low level of understanding the language of instruction.

In Nigeria, the effect of language background on students' performance could be observed at both the National and International examinations. In the recent examinations, less than forty percent (40%) of the students who sat for the examination (WAEC) have at least five credit and above including English and mathematics. This is a concern among the mathematics educators and among the stakeholders in education. Table 1.1 indicates the trends of the results for a period of three years.
Table 1.1: WAEC Results in Nigeria, 2012-2014: Mathematics and English language Paper 2.

<table>
<thead>
<tr>
<th>Years</th>
<th>Number of Entries</th>
<th>% Performance</th>
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<tbody>
<tr>
<td>2012</td>
<td>512,981</td>
<td>38.81%</td>
</tr>
<tr>
<td>2013</td>
<td>519,321</td>
<td>36.75%</td>
</tr>
<tr>
<td>2014</td>
<td>529,425</td>
<td>31.28%</td>
</tr>
</tbody>
</table>

Source; (WEAC/SSC, 2015)

Table 1.1 shows the performance of students in Nigeria for the first three years (2012-2014). The decline of this performance can be observed in 2014, where only 31.4% of students scored a credit and above in both mathematics and English language. This trend indicated a serious decline in students’ performance in mathematics as compared to their performance in the years 2012 (38.81%) and 2013 (36.5%) respectively. This finding also agreed with Mohammed (2012) who also reported that the average of students’ performance in mathematics in the national examination was only 38% (JSSCE, 2006). Mathematics essay paper (Paper 2) presents most of the questions in words, and worded problems. The essay paper aspect of test items constitutes a high percentage of students performance score in general mathematics. Therefore, students’ proficiency in the text language and language of instruction becomes necessary as it determines student’s achievement in mathematics.

Moore (2005) observed that students’ ability to interpret mathematical expression or word problems given to them is based on their level of understanding of the
language of instruction and the method of teaching. A large number of the existing literature on algebraic word problems focusing on arithmetic word problems, mainly at the lower secondary level of education viewed that, for students, finding solutions to one or two-step algebra word problems experience more difficulties, especially those that involve comparing, changing, and combining quantities (Adetula, 1989; Verschaffel et al., 2000).

Word problems are English written statement (real-life contexts and situations) which enabled students to first focus on understanding the question (Chapman, 2006). The National Council of Teachers of Mathematics opines that teachers teaching algebra word problems at any level in the middle school (Grade 8), should always develop a mathematical statement (equation) that can represent the problem. It further suggested that students should be engaged in the developmental approach and this would prevent them from depending on intuition approach (NCTM, 2009: 35).

Algebraic word problem are English written statement and are representation of the real life situation. Mathematical information can be used to represent the real situation and can be models which can take the form of an equation (English, 2007 & Forstern, 2010). These equations or models can be developed through a series of processes known as modeling. This modelling helps students select appropriate variables that can be used to solve problems. The procedures that are involved in the modelling leading to the required equations are known as mathematical modeling. Therefore is the process of
transforming word problems into an algebraic expression (English, 2007). The established equations or algebraic expression represent the real world situation which when applied to the stated problem would provide a solution that is needed.

Modelling is used to promote students engagement, discussion and making an algebraic expression from the real-life situations (Anhalt & Cortez, 2015). The purpose of mathematical modelling in this study is to have students develop mathematical statement from word problem context at the same time. The students are to develop ideas and representation and eventually lift those ideas into pattern and generalize the situation to describe what they are seeing and this will give them the ability to learn mathematics or algebraic word problems. Solving algebraic word problems require processes such as comprehension, selection, mathematize, solving, computation and testing in order to get an accurate result and this can be in cyclic process (English et al. 2005; Sole, 2013). The correct result is the representation of relevant features of a real-world situation. The representations of those features in a symbolic form are aimed at developing an equation that can analyze and provide an accurate solution to the given problem (NCTM, 2000).

National Research Council (NRC, 2001) views that when students learn a mathematical approach (Mathematical modeling), they are likely to have a clear and definite solution when solving word problems. The same technique or approach can also be applied to other word problems. When students are familiar with the new technique they will develop confidence in solving related word
problems. These will also enable to see themselves as problem solvers in their daily thinking. Limited knowledge of the mathematical modelling in solving algebraic word problems is a serious challenge to students’ achievement in the subject (NCTM, 2012). This challenge does not only remain with students. Mathematicsteachers’ failure to convey relevant message (subject matter) to their students remain a serious challenge to the education sector. These may leads to students’ phobia and lack of interest in the subject.

In Nigeria, evidence of this were observed when teachers were provided with solution to the test items from the beginning algebra (Ladele, 2013). Teachers were required to provide correct answer to a wrong one, or confirm a correct answer, and identify the mistakes that they believed might have led to the students’ incorrect solutions (Ladele, 2013). The purpose of this activity was to help the teachers see the issues from the students’ perspective and to find out how much they knew about the existence of algebraic word problems. It was very surprising that some of the teachers arrived at wrong answers and by the amount of discussion the question generated. Some teachers themselves appeared to initially struggle with the meaning of some questions and they also appeared to be unaware of misconceptions about variables and expressions.

Solving word problems require the knowledge of mathematics, the language of the text and the language of instruction, which learners need to acquire and apply (Jitendra, 2009). However, it is often assumed that an understanding of solving word problems will be picked up if students are grounded in the new approach of
problem solving (Ladele, 2013). Mathematical modelling approach in mathematics classroom cannot be overemphasized as this would provide leaners with necessary skills of solving word problems. In Nigeria and Bauchi State in particular, students’ poor performance in mathematics over the years has indicated their inability to use relevant approach in solving word problems. This study therefore, sought to find out if mathematical modelling approach would make word problems easier to be solved by the Nigerian junior secondary school students and also find out how their proficiency level of English as a medium of instruction in the mathematics classroom would be improved based on

1.2 Statement of the Problem

Proficiency in English as a second language and as a medium of instruction in mathematics classroom is a contributing factor to good performance of students in mathematics. In Nigeria, the leaning of mathematics is English language ((NPE; 2004; David; 2011, Adeyemi & Adeyemi, 2012). learners with low level of proficiency of the language of instruction performed very low in mathematics. Other reasons that can contribute students’ poor performance in mathematics may include large class size, students’ language background, sex, teachers approachand learners understanding of the text language. These remain a serious problem to secondary students in learning mathematics.

The seriousness and urgency of the situation is reflected in the results of 2014 West African School Certificate Examinations (WASCE) in which only 31.8% of the students scored a credit in Mathematics and English language. The continuous
Decline of students' poor performance in mathematics at both JSSCE and WEAC level of examinations is not surprising as the mathematics essay paper (Paper 2) presents most of the questions in words, and worded problems. Developing relevant equations in word problems is necessary (NCTM, 2009: 35).

Word problems often require the use of algebra to solve them. Solving word problems at levels beyond the primary school most often involves interpreting and translating the sentences into algebraic forms before mathematical operations are carried out. To be successful in solving word problems, students need to learn how to read such problems. Simply decoding words or extracting arithmetic operations is not enough: students must learn to read between the lines and understand what they are expected to do mathematically. Proficiency in both English and mathematical language by learners is necessary for success in problem-solving.

Given the complexity of teaching mathematics in multilingual classrooms, connection between classroom mathematics activities and everyday life knowledge of both teachers and learners is far from being accomplished. As a result, the real-life application of mathematics and sense-making of verbal problems (word problems) to solve problem situations in the real world, otherwise referred to as ‘mathematical modelling’ and is viewed as a required process that can be acquired and achieved by second language learners. Ladele (2013) in his study sought to identify difficult areas of the Nigerian JSS1 in their solutions to general algebraic problems, by giving 181 students questions from all
components of the beginning algebra. His study reported a 30% pass in the algebraic word problems component, indicating the need for a focus on algebraic word problems since it features in all secondary mathematics.

The Federal Government of Nigeria however, recognizes that consistent quality of teaching and learning remains a significant challenge which can be addressed so as to improve learners' performance in the subject. The aim of the Junior Secondary School Mathematics curriculum in Nigeria is to provide mathematical literacy to all students (FMoE, 2007). To this effect, students should be able to solve word problems and represent them algebraically in their second year in secondary school as they transit from arithmetic to algebra. One way of trying to find out what makes word problems difficult was to investigate the effects of English as a language of instruction in teaching and learning mathematics and also to see if mathematical modelling would make word problems easier to be solved by the Nigerian junior secondary school students. This initiative should be taken to fill such a gap and stands as a step in this direction.

1.2.1 Purpose of the Study

The general purpose of this study was to assess the effects of English Language on the teaching and learning of mathematical modeling at junior secondary level in Nigeria. Teachers' proficiency levels of English language, their approach in teaching algebraic word problems as well as their preparedness are among those challenges that were investigated. The study was to seek to analyze those
challenges and propose alternative ways of enhancing students’ achievement in mathematics in Nigeria.

1.2.2 Objectives of the Study

The study was guided by the following specific objectives:

i) To establish teacher’s proficiency level of English as a second language in teaching and learning of JSS2 algebraic word problems.

ii) To determine teacher’s level of preparedness in their use of English in teaching and learning JSS2 algebraic word problems.

iii) To find out the effect of English Language on JSS2 performance in word problems through mathematical modelling.

iv) To find out the effect of mathematical modelling on gender performance among junior secondary school students in Bauchi-Nigeria.

v) To formulate mathematical modeling approach that would enhance junior secondary school students’ performance in word problems.

1.2.3 Research Questions

The following research questions were developed to guide the study, these included:

i) What is the teacher’s proficiency level of English as a language of instruction in teaching and learning of mathematical modelling at junior secondary school level?

ii) What is teacher’s level of preparedness in their use of English in teaching word problems at junior secondary school level?
1.2.4 Hypotheses of the study

The following null hypotheses were formulated to guide the study, these included;

i) \( H_01 \) There is no significant difference in the effect of English Language on junior secondary school students’ performance on word problem.

ii) \( H_02 \) There is no significant difference on the effects of mathematical modeling on gender’s performance in word problems.

1. 3 Significance of the Study

The significance of every study is its findings, for this, the study would;

i) Certify and address some key concepts such as effects of the second language, teachers’ proficiency level, teachers’ preparedness among others as they relate to teachers knowledge of mathematics.

ii) Establish theoretical understanding of English Language through teaching and learning mathematical modelling that be useful to the Ministry of Education as it will provide relevant suggestion which can be used in the formulation of training policies and practices for secondary teacher education.

iii) Will enhance the teacher pedagogical content knowledge, how a teacher can teach the subject content and the language of mathematic.

iv) Be useful in the identification and correction of students’ misconceptions in solving algebraic word problems in mathematics at internal, national and international examinations levels.
v) Be helpful in enabling learners and teachers alike; effectively acquire new and relevant concept and practical skills, thus becoming innovative and responsible in teaching and learning mathematics. Address an existing knowledge gap in the area of teaching and learning mathematics in Nigerian secondary schools.

1.4 Delimitation and Limitation

1.4.1 Delimitation

The research has considered only government secondary schools, specifically junior secondary school two students (JSS2). Other classes were not considered in the study due to the study being an experimental research. The choice of the level and the class in this study was that, the junior secondary level is the connection between the primary mathematics syllabus and the secondary mathematics syllabus. The class has also experienced the beginning algebra in their first year (Ladele, 2013). The study was delimited to instruction specifically involving mathematical modelling approach. The study has also involved mathematics teachers only in the public and boarding schools from the study area.

1.4.2 Limitations

The first foreseeable was the distance from the researchers host university (KU) and Bauchi Southern Educational Zone of Bauchi State, Nigeria, the place of data collection. This long distance would have affected both the time and the budget available for the research. This problem was addressed as the researcher got an introductory letter from the department immediately after the submission of the
proposal copy, seeking permission for the researcher to visit the study school through the directive from the Bauchi State Ministry of Education. The permission was granted two weeks to the commencement of the intervention and data collection. The state government which is also the employer of the researcher assisted and sponsored the field work through the Tetfund intervention.

The second limitation was the issue of unexpected transfer of one mathematics teacher after the period of the training that was likely to be involved in the intervention. This problem was almost addressed as a special arrangement was made between the researcher and the Head of the new posted school to allow the trained teacher to take part in the study. This would have affected the findings of this research work.

Academic calendar was almost tampered with as the Bauchi state government declared one week break. The break was as a result of Sallah celebration, this made the researcher to adjust his research schedule slightly for a week. A permission letter was received from the Ministry of Education. There was no any break again from the commencement to the end of intervention.

Finally, there was a scarcity of research findings on the effect of English Language as medium of instruction in teaching mathematics within Bauchi State, Nigeria. These revealed that reference on previous studies and findings in the area were confined to both local and foreign sources.
1.5 Study Assumptions

The study assumes that:

i) Teachers of mathematics at junior secondary schools had minimum teaching qualification.

ii) Teachers have covered JSS 1 and JSS2 aspect of algebra word problems in their mathematics classroom.

iii) Students were taught early algebra in their primary mathematics and in their first year of junior secondary school mathematics.

1.6 Theoretical Framework

This study was framed within Piaget’s (1967) constructivist theory. According to Piaget, constructivism is a cognitive learning theory with a distinct focus on the mental processes that construct meaning. This meaning requires knowledge building from experiences in terms of existing knowledge. In particular, students individually construct their pattern of reasoning which leads to the action they take. So, in learning mathematics, a learner relates known patterns which lead to new ones (Herbert & Carpenter, 1992). In the same way, learning mathematics is viewed as a gradual process of learning to master the mathematic registers as learners proceed in their levels of education (Moschkovich, 2002).

From a constructivist’s perspective, knowledge cannot be transferred, being intact, from one individual to the other in ready-made fashion. The child is seen to be the active player in the acquisition of new knowledge. The child is responsible
for the construction of his knowledge through the interaction of new ideas with his prior knowledge.

Constructivism recognizes that individuals do not learn in isolation but learn within an organized and clear environment in which knowledge is planned with others (Frank, Kazemi & Baltey, 2007). Each individual presents knowledge which is a potential springboard to move to higher stages of knowledge acquired and with assistance, this is ‘achievable’ (Vygotsky, 1978). The theory is the process of communication, interaction and construction using mathematical terms and words which mathematical concepts are learnt and learning occurs (Lim & Presmeg, 2011). In constructed classroom, a mathematics teacher does not focus primarily on the correctness of solution to existing problems but on the approach which individual learner uses when solving a given problem and this can be complemented by using a mathematical modelling that can be applied to solve related problems (Hensberry & Jacobbe, 2012).

Constructivism theory believes that an individual develops his reasoning with the pattern he sees (Major & Mangope, 2012). The classroom is a constructed place which is situated in a society. This is where a professional teaching and learning take place and are made available for each individual to internalize and construct knowledge that is useful in the learning of mathematical concepts. In this theory, also, the child is responsible for the construction of his knowledge, through the interaction of new ideas with his prior knowledge (Major & Mangope, 2012). A mathematical modelling therefore, functions as an intellectual
tool during the process of learning mathematics and particularly word problems where a child can read, comprehend, transform, operate, formulate and produce a solution to a given problem.

The learning process would enable the learner to retrieve and apply it at an appropriate time during the learning process. Constructivism theory, therefore, forms the bases for this study since the aim of the study is not only aim at making learners find solution to the existing problems but to inculcate in learners' skills and abilities to become good problem solvers through mathematical modelling procedures.

1.7 Conceptual Framework

The study adopted constructivism theory, since the theory is concerned with learning through the active participation of students in the learning process. The teacher on the other hand remains as the resource person who works and provides all avenues for learners to acquire a new concept through a gradual and continual process (Major & Mangope, 2012). In this theory, the teacher provides a conducive environment for students to acquire new knowledge and use the knowledge acquired to solve relevant and related problems.
The Conceptual framework in Fig. 1.1 shows variables that interact to influence students’ performance in mathematics. These variables are; English language for the independent variable, the teacher- mathematical modelling approach and the understanding of the subject matter, Student gender and background for intervening variables and while improved students’ performance in mathematics for the dependent variable. The interaction of these variables has created new knowledge in teaching and learning of word problems and mathematics in general.

The study was also based on the assumptionstudents or leaners cannot only be blamed for their poor performance in the subject butthat the kind of method and their background in the language of instruction can also influence their poor performance in the subject (Wambugu & Changeiywo, 2008).
The study used mathematics teachers with more than two year teaching experience, involving junior secondary school students who were in their second year. The study used only public boarding schools at the junior secondary level in the same schools. This was to provide a clear scope of the study with regard to the choice of schools and level of students. In this study therefore, the teaching approach used influenced the learning outcomes.

1.8 Chapter Summary

The concept and importance of mathematics in the school and the society have been discussed. The need for proficiency of English as a second language in learning of mathematical modeling in Bauchi State- Nigeria was highlighted. Also the need for the students’ perception of mathematical modelling in solving word problems was also highlighted; the statement of the problem has been outlined. Theoretical and conceptual frameworks have been outlined. The significance and the purpose of the study were also highlighted. It also shows why there was a need for the study to be carried out.
1.9 Operational Definitions of Terms

**Effect:** level of knowledge expected in learners’ achievement after receiving an instruction.

**Junior Secondary Education:** secondary educational level between primary level and senior secondary level of education.

**Linear equations:** mathematical statements with one or two variables which represent the language of the text.

**Modelling:** ability of learners to relate variables that represent the text language of a given problem.

**Mathematical modelling:** procedures for developing an equation in solving word problems.

**One-step problems:** word problems with a single mathematical operation in the statement.

**Problem solving:** the procedures of translating and interpreting word problem into mathematical format and solution to problem.

**Second language** (SL): language of instruction used by teachers in teaching mathematics at junior secondary school level apart from their first or the mother tongue.

**Students’ proficiency:** learner’s level of understanding of both the language of instruction and the new concept to be learnt.

**Students’ performance:** students demonstrated ability to solve word problems efficiently.
Teaching and Learning: interaction between teachers and students in acquiring new skills or concept.

Teacher preparedness in using English- teachers’ ability in sustaining learners’ interest in word problems

Teacher proficiency of English language: teachers’ ability to use English language to teach the mathematical modelling.


Word problem: written sentences or English frame which can be translated into mathematical terms or algebraic expression.
CHAPTER TWO
REVIEW OF RELATED LITERATURE

2.0 Introduction

The review of related literature has been carefully examined based on the stated objectives that the guided study. The review assessed was based on the effects of English language on teaching and learning of mathematical modelling at junior secondary school level of education. Thus, the related review is presented under the following subheadings; mathematics and language teaching policy, mathematical modelling and models, mathematical modelling and proficiency in the second language, effects of second language on mathematical modelling and achievement, gender and academic performance in mathematics, mathematical modelling and learning strategy (problem solving), improving mathematical knowledge through modelling, teacher pedagogical knowledge of mathematical modelling, views/arguments on second language and understanding mathematics and summary.

2.1 Mathematics and Language Teaching Policy

Mathematics is a universal and general field of study that affects all aspects of human life. The language of instruction especially at the secondary school of education has to be specified, acknowledged and accepted globally (Fajemigba, 1991). In the choice of the language of instruction, both teachers and students or learners most have certain proficiency level of that language (Fajemigba, 1991 & NCTM, 2012). Mathematics is a field of study that deals with figures and
symbols which are all terms as algebra, because mathematical statements are representation of the real life situation (Odili, 2006).

Learning mathematics especially at the secondary level of education is guided by language polices that are universally or globally accepted and are recognized (NCTM, 2009). The need becomes necessary so as to pave way for all learners have asses to advance mathematics courses and also to carry everyone alone (NCTM, 2012). The language of instruction must provide leaners with the proficiency of the text or material that is to be learnt. Students have to learn the language of Mathematics (variables, syntax, and vocabulary) and become familiar in translating variables into meaningful representation such as the graphs, equations, models, pictures (Benson & O’Connor, 2015). They would also translate mathematical language into the language of instruction and also have the ability to translate the text in the language of instruction into mathematical terms (Neuman, Newman & Dwyer, 2011).

Dearden (2014) in her study on English as a medium of instruction in sciences, social sciences and mathematics – a growing global phenomenon viewed that teaching polices that recognize English as a medium of instruction in mathematics and other sciences can attract high fee-paying international students on quality research papers in mathematics, helping them move up in the international rankings. English Medium of instruction (EMI) in mathematics is also as a way to improve communication, to exchange ideas and create relations between countries, even a way of facilitating world peace as well as a key to success and a
way to open doors for their home students (Dearden, 2014). A real language is a language that exists in all fields of life and therefore when it comes to mathematics learning at any level of education, English is the best acceptable medium of instructions in Nigeria and beyond as it is an indispensable tool of expression and communications (Ewetan, 2015).

AIPME (2011) reported that in the US, policies for educating students from minority language groups differ greatly from location to location and are often geared toward cultural assimilation. In California, citizens voted to eliminate non-English teaching from government institutions, compelling teachers to use the acceptable language of instruction in their various subjects. Texas has instructed students in their first language for several years before transitioning to the majority language and led such students to take the state assessment in their primary language up until sixth grade.

Cuvelier, Plessis, & Teck (2003) on their findings on second language learners in South Africa found that there are eleven official languages used at both secondary schools and tertiary institutions. The choice is either to use English or Afrikaans as the medium of instruction. In learning mathematics and other science subjects, most parents and communities in South Africa prefer their children learn mathematics in English which is the acceptable international and official language. Possible reasons might be to ensure a successful financial and social future (Kezami, 2008). Parents may think it necessary for pupils to know an international language such as English. English is spoken as a first language by
less than ten percent of the population and is the language of business and government. This indicated that English is a strong factor in determining performance in mathematics. Sarah (2003) in her study on language and other background factors affecting secondary pupils’ performance in Mathematics in South Africa revealed that the students’ proficiency of English was a strong predictor of their success in mathematics. Policy recognizing English as a medium of instruction would highly determine students’ performance in mathematics as other languages are only based on translation mathematical terms rather than focus on the comprehension of the terms (Kazima, 2008).

Kenya has often opted for subtractive and transition models in her educational policy (Kejeri, 2013). The motives behind the two models (subtractive and transition) was to provide a smooth transition of learners knowledge from home language learning into the second language learning. In Kenya the second language learning is language of instruction in the mathematics classroom at the secondary level of education (Wasike, 2006). The learners may begin school in their mother tongue and then gradually move towards the second language as the medium (Khejeri, 2013). If the transition to the second language takes place within a period of three years, this is called an early exit transition model, and then transition model takes place. The benefit of this model is that young children are quicker at picking the second language more than the adults and that they will be more fluent in the second language if they are exposed to it early. This has been witnessed in many cases where children who are exposed to second language
(SL) at an early stage tend to speak the second language (SL) fluently (Khejeri, 2013).

In Kenya, many speech communities are linguistically heterogeneous, so they mainly choose English or Kiswahili as a language of instruction from lower primary through secondary school (Sibonman, 2015). English being the language of instruction at higher level of the education ladder, those that choose English as a language of instruction presumably have a head start over those that use the Mother Tongue. During mathematics instruction, teachers and learners are continually engaged in linguistic activities especially on word problems. Teachers are required to develop in the learners the ability to read the text language through elaboration, paraphrasing and modeling procedures (Kazima, 2008). Learners can therefore translate the linguistic statement into mathematical representation.

Language used in teaching and learning mathematics is a central aspect in schools and classrooms.

In 2003, the Malaysian education policy makers recommended the use of English as language of instruction in science and mathematics at all levels of education (Ismail & Awang, 2009). This directive was being implemented in parts. At the basic level of education, it involves beginners and at the upper level it involves class one and pre-degree learners. This policy was implemented at all levels of the national education system after a period of five years (Chan & Helen, 2006). At this stage of industrialization and internationalization, children must be provided with access to new discoveries in science and technologies but this cannot be
possible if learners proficiency of the language of instruction (English) continue to remain very low especially during their secondary level of education.

In Nigeria, her educational system consists three major phases. These are the basic, senior secondary and tertiary levels of education. Although the basic level is taken as the first major phase, early childhood education has a very strong visible presence and operates within private schools (David, 2011). The National Policy on Education adopted six years as the entry age into the basic level, which covers a period of nine years, this level of education consist of six years at the lower basic and three years at the upper basic (NPE, 2004). The compulsory nine years of schooling has increased the number of students and schools, teacher shortage and an attendant increase in teacher workload.

In Nigeria there are other three languages (Igbo, Hausa and Yoruba) of communication during the period of formal education (David, 2011). These three languages are spoken at the lower primary level. The Federal Republic of Nigeria in indicated that teaching in the first three years of basic education should be in the child mother tongue (NPE, 2004). After the first three years, English is the language of communication until the end of formal education. The implementation of this policy aspect is less rigorous in the private schools, so children are taught in English not only in lower primary classes but also in the nursery schools. The immediate focus of policy with regard to English as a language in teaching and learning was its major role in the major/ national languages of the world and as a medium of instruction in the Nigerian system of
education (Danladi, 2013). English language has provided Nigeria with access to the international communities (Olanipekun, 2013; Olanipekun & Shola, 2014).

Another reason offered was that, for teachers to be able to successfully teach students in their mother tongue, they need to understand which words in the relevant mother tongue have different connotations and meanings (Awofala, Nneji & Fatade, 2012, p. 117). For example, different words are used for measurement and capacity and for geometric shapes and mathematical concepts. Adding to the challenge, many words used in mathematics do not even exist in some indigenous languages, so word-for-word translations are not always possible (de Bengoechea, 2008).

A major realization from the policy is that “no educational system may rise above the quality of its teachers” (FMoE, 2007). Recognition of the quality and role of the teacher led to the development of a teacher education policy in 2009 that was fully implemented in 2013. The existing challenge in the sector is to be redressed through initial training that is focused on subject-content and pedagogy, and professional development for in-service teachers in various fields (FMoE, 2009).

Awofala, Nneji & Fatade (2012, p. 117) in their studies on importance of language policy in the learning of science, technology and mathematics (STM) in Nigerian secondary schools have recognized English Language as a medium of instruction in STM classes at the secondary school level. This has positive effects on students’ performance in mathematics. The discussion was supported with the
report of a study in which students’ performance in English Language and in each of mathematics, biology, chemistry, physics, technical drawing, further mathematics and agricultural science in the West African Senior Secondary Certificate Examinations (WASSCE) were correlated.

Abedi (2001) assessed the effect of the proficiency of the medium of instruction on students’ performance in mathematics. Analysis revealed that students’ performance may be connected with their proficiency level of the text language. In view of this, students with high proficiency of the language of instruction (English) can perform better than those with low proficiency of the medium of instruction which is the second language. This is a clear indication that proficiency in the language of instruction by students learning mathematics can influence their performance in the subject. Adegoke (2010) in his study, found that among the Yoruba people in Nigeria, students who were rated with good understanding in the second language did significantly better in mathematics than their colleagues who were classified as being low understanding of the second language.

Bergeson, Fitton & Bylsma (2000) on their research, moving from the traditional teaching to the modern teaching found that students, when faced with task which is English written statement in mathematics, they tend to develop phobia and frustration as most of the problem demand procedures in getting solution to the problem. Esan (2015) perceived word problems as English written statements and cannot be solved by trial and error method or just getting solution through simple
computations but rather a define procedure has to be follow in getting solution to the problem. English & Watters (2005) viewed these proceduresas mathematical modelling process and if properly follow and perceived by students then a model or an equation can be develop to represent the real-life situation. In view of this therefore, student’s proficiency or understanding of the text language and language of instruction becomes very important.

Adeyemi & Adeyemi (2012) in their study on effect of the second language on Junior Secondary School performance in social studies in Nigeria observed that the government, in recognizing the importance of language, enacted a language policy and documented in the National Policy on Education. This makes English language play a significant role in the Nigerian education sector. Adegboye (1993) affirmed that choosing English as language of instruction in teaching and learning mathematics counts a lot in determining the level of students performance in mathematics. He further maintained that lack of proficiency in English language is one of the factors contributing to poor performance in Mathematics. In his research, he observed that the performance of students in Mathematics examination at SSCE is poor but further stated that the performance in English is more than that of Mathematics and this he linked to poor reading ability.

Ayodele (2001) compared the result of Nigerian senior secondary school students at the external examination (SSCE) with some students of the same level in some few West African countries. This comparison were made into consideration were
English language is a second language and also the language of instruction. In his findings that he found that most Nigerian students who were the majority was getting low performance when compared to the West African countries. Adeyemi (2011) observed a similar low performance of students in Nigeria in both mathematics and English at WEAC/SSCE levels of examination from 2002 to 2009. Result indicated that there was no year where the performance level reached a credit level in mathematics. This clearly shows that most Nigerian students could not comprehend most of the text language which are English written statement. This study therefore, sought to investigate the effect of the second language on students’ performance in mathematics in Bauchi State, Nigeria.

2.2 Mathematical Modelling and Models in word problems

It is important to know that, algebraic word problems are English written statement with symbols, figures or values (Ladele, 2013). This aspect of mathematics requires procedures that can represent meaning of the text language (Moschkovich, 2005). The meaning therefore gives the exact representation of the problem. Research indicates that, modelling and models are often considered as the major procedures that can be used in teaching and learning algebraic word problems (Lesh & Doerr, 2003).

English, Fox & Watters, (2005) viewed that modelling and models are integrated procedures. Modelling is a process that involves series of steps in getting solution to a given mathematical problem. The approach spells out the existence of the problem and proposed solution to the problems (Lesh & Zawojewski,
Model on the other hand is an equation in modelling procedures. Mousoulides (2007) viewed modelling approach in a problem solving situation as an approach that concern with the explanation of the existing data and goals as major requirements that are needed in getting solution to the problem. In this study therefore any equation developed which give meaningful representation (solution) of the problem is viewed as model or models. The modelling procedures lead to the formation relevant equations (Omobude, 2014). This indicates that models are inherently provisional, mainly ready to be used whenever the need arises.

Greer (1997) views modelling as a social interaction between teachers and learners in learning any mathematical concept. In view of this, modelling procedures is the mathematical statement, equation, algebra statement which when formed or developed represent, explain and describe the real life situation (word problems). The developed equations are called models and the accumulation of experiences using figures or symbolic representation over time (Lesh & Lehrer, 2003). Shin and Kim (2011) maintained that modelling procedures in word problems can lead correct equation or an algebra that can give sense to problem situation in which the current learning process (problem solving strategy) is lacking as it fails to interpret and spell out the goals and givens of an existing problem. In a modelling cycle, competing, interpretations are gradually sorted out or integrated or both and in which promising trial descriptions and explanations are gradually revised, refined, or rejected. This kind of approach will be more effective in word problems.
Solving algebraic word problems can be difficult to students. This requires students’ proficiency of the language of instruction. Students must learn how to read between the lines and understand what they are expected to do mathematically (Barwell, 2011). Mathematical modelling in this study is viewed as an English supportive programme. It requires that, teachers should engage students in understanding, mathematizing, analyzing and communicating in the context of meaningful situations and problems (Shin & Kim, 2011). This promotes a greater understanding of how word problems work as texts. In the same way that, an understanding of the structure of stories makes students better readers of stories, so an understanding of how word problems work in mathematics make students better readers and problem solvers (Barwell, 2011).

In modelling word problems, there is the need for a proficiency in the language of instruction by the teacher or else students are likely to experience difficulties in using the process. Difficulty in translating and providing solution to word problems depends on leaners ability to perceived and contextualize the text language which can be refrain and change the problem into an algebraic or into a mathematize form. The equation or the mathematical statement been formed are used to solve related problems. Salman (2002) agreed that students often commit much errors in algebraic word when translating the problem into mathematical statement or a required equation, these kind of errors are usually call reversal error. Ladele (2013) in Nigeria found that, students were given a task in word problem at JSS1 and where required to translate the problem into the
required and obtain the solution to the problem. Most students could not get the solution correctly but rather end of committing reversal errors.

Clement & Marks (1981) opine that, this kind of error committed by students is their inability to contextualize and represent the word problem into the required equation. Most students can read the problem but cannot comprehend the text language in the given problem; this may be due to the fact that they lack the proficiency of both the language of instruction and the text language. To comprehend the text language particularly in algebraic word problems, Eric (2009) viewed that students needs to paraphrase, explain, categorize, find relationships, dimensionalise, quantify, or make predictions from a given task, they are generally developing their conceptual systems or models through the mathematizing. As they work with the rich contextual data, they would need to surface and communicate their mathematical ideas to clarify their thoughts and weigh the validity of their ideas.

Mousoulides (2007) in his study on Mathematical Modelling for Elementary and Secondary School Teachers in Cyprus viewed mathematical modeling in words problems as an effective medium not only to answer questions to problems that are already formed but it promote the understanding of relationships among mathematical ideas, variables, symbols and words that exist within a problem situation. This recommendation can be pushed further and modelling activities can be used as a way to cultivate critical thinking and critical literacy (Sriraman & Lesh, 2006).Modelling activities can assist students in using algebraic ideas in
providing solution to word problems. The procedure develops an understanding of students’ thinking, hence increasing their problem solving abilities (Lesh et al., 2003; Mousoulides, 2007).

An example of modelling activity for students in word problems is intended to reveal the way students are thinking about a real life situation. This can be mathemtized through modelling (Mousoulides, 2007). The required solution needs a cyclic approach so as to get the relevant model by the client. This gives the students the ability to describe the procedures used in getting the accurate result and justify not a single solution, but rather all (or most of) the optimal and appropriate solutions (Mousoulides & English, 2008). Students’ engagement with such mathematical tasks results in developing math concepts through the need to develop powerful math ideas in order to solve a problem. Thus, they are given a purpose to develop a mathematical model that best explains, predicts, or manipulates the type of real-life situation that is presented to them (English & Lesh, 2003). In this way, model-eliciting activities allow students to document their own thinking and learning development. Lesh et al., (2003) & Mousoulides (2007) suggested a modeling procedures as a best strategy in teaching and learning word problems in Cyprus secondary level of education. Fig 2.1 presents the modeling procedure.
Lesh et al., (2003) further maintained that in a modeling circle, teachers are to simplify the problem for easy comprehension by the learners and this can be done through using information from students’ background knowledge to understand the information given. In essence teachers are to manipulate the problem and develop a mathematical model. This would help learners identifying the variables, make decisions about variables and propose solution based on the variables from the problem. Learners ability to comprehend the text language would help them verify, validate and reflect the problem solution. This development therefore becomes a paradigm shift in the implementation of Cyprus elementary and secondary mathematics curriculum by School mathematics Teachers (Mousoulides, 2007).
In Nigeria, the new national mathematics curriculum for primary and junior secondary schools is focused on giving the children the opportunity to acquire mathematical literacy to function in an information age and cultivate understanding of the skills necessary for the changing technical world (Cecilia, Anne & Nnenna). According to Ekwueme & Meremukwu (2010), the current curriculum is aim at making students see mathematics in the real-life context rather than in an abstract concept. In this initiative, there is an attempt to include the concept of mathematical modelling as a new strategy in learning word problems and mathematics in general (Omobude, 2014). The modelling activities are aim at making students see mathematics in a real life context (English& Lesh, 2003). The intension for the reformed of the news curriculum is to ensure that all mathematics textbooks especially at primary and junior secondary level should include concept of modelling in teaching and learning mathematical concept.

Modelling in teaching word problem in Nigerian secondary is very important as it would help teachers manage the multiplicity of ideas in the class and to support the multiple developments of students’ ideas (Omobude, 2014). Thus, there is a need to explore alternative strategies that can be manipulated to promote students’ attitudes toward mathematics word problems as current results (Adegoke, 2013) reveal that the traditional teaching approach is deficient in meeting the needs of teeming learners. Therefore, effort is made in this study to investigate the effects of mathematical modeling on students’ performance mathematics word problems.
2.3 Mathematical Modelling and Proficiency in Second Language

In the recognition of challenges of second language in mathematics classroom as a global challenge, the National Council of Teachers of Mathematics, recommended that all multilingual and bilingual learners who are learning mathematics and science subject not in their first language should be given equal treatment and opportunity to attend all aspect of mathematics especially at the secondary level of education, as these remains as the basis for learning advanced mathematics (NCTM, 2009 & 2012). In carrying all learners along during mathematics lesson and especially algebra word problem lesson, teachers should emphasize class discussion, communication and reading habit as these will improve learners’ proficiency in both the text language and the language of instruction (PSSM, 2000: p.60, & NCTM, 2012).

Dawe’s (1988) in the study of second language students, showed that the correct use of logical connectors was the one factor that affect students’ performance in mathematics. A clear reason is that those students who are learning through the second language could not reason mathematically in English. This was supported by Mousey & Marks (1991) who viewed that both bilingual and multilingual students in the mathematics classroom may find it difficult to relate mathematics problems with their second language background.

Thompson (2008) in her study on improving second language learner’s performance in mathematics viewed that second language learners can perform better in mathematics. She maintain that teachers can make effort by encouraging
second language learnt mathematics through remedial and extra lesson, child centered in learning mathematics remain as a key factor for success in learning mathematics, this can be done by engaging learners participate fully in the lesson and using simple and relevant terminologies to explain situation and why such situation occurs. Such efforts can provide an opportunity for second-language learners overcome those differences that can affect their ability to communicate mathematically’’ (NCTM, 2000: 200).

Language and culture provide a dynamic teaching and learning mathematics especially algebraic word problems, reading skills is a good background in the language of instruction (Percy & Andrew, 2014) In today’s classroom, students learn mathematics with communication demand (oral and written) which require participation in mathematics process and practices such as explaining solution process, providing conclusion and making argument and justification. These processes relate to acquiring technical vocabulary, developing comprehension skills necessary to read and understanding various mathematical facts in solving algebraic word problems (Moschkovich, 2005).

Algebraic word problems are English written statements that involve both numerical and variables in the text language (Semadeni, 1995). Teachers’ ability to teach this aspect of mathematics requires not only the proficiency of the language of instruction but also the procedures needed in understanding the text language so as to carry all learners along ((PSSM, 2000: 60, NCTM, 2009). Studies have indicated that, students’ success in algebra aspect is his ability to
comprehend and select relevant data and variables and developed models or equations to solve the problem (Ladele, 2013). The leaners ability to use such equations in solving related problems always enhance his achievement in the subject (Knuth, etal, 20005, p.68; Walder, 2010).

Latu (2008) in her studies on Language Factors that affect Pasfika students’ performance in Mathematics, opines that, algebraic word problems provide some of the more cogent examples of mathematics discourse features at work, processing sentences in such a linguistically dense context, coupled with the logical nature of many mathematics problems, requires the reader to rely on the sentence to convey clear and unambiguous meaning. Yeo (2009) viewed that students’ ability to read in the language of instruction is vital to their mathematics, but she or he is continually hampered by reading problems, frustration and lessening of self-expectation is likely to occur. The way students read the systematical structure of sentences, relational statements, order of sentences and logical connections have all been identified as potentially hindering conceptual understanding (Dale & Cuevas, 1987; Mousley & Marks, 1991).

In the United States, this concern has risen in part because of a continuing growth in the number of students in mathematics classes who have a limited proficiency in English. The National Center for Education Statistics projects viewed an increase in the number of such students ages 5 to 14 from the 1980 level of 2.4 million to 3.4 million by the year 2000. An inadequate grasp of the language of instruction is a major source of underachievement in school. The claim was that
students who do not understand English are effectively foreclosed from any meaningful education. In USA, a research has shown that there is growing number of students for whom English is not their first language of communication. The students are often denied access to full curriculum in mathematics and the resulting opportunities for higher level of educational experience in mathematics (Perez, 2012).

Setati et al., (2008) study which aims at helping learners with this problem of comprehension of word problems by using the learners’ home languages as resources in the classroom offers versions of word problems in the learners’ home languages. They conclude that this strategy improves learners’ comprehension of the word problems and so makes the mathematics accessible to all the learners because they focus on the mathematics and not the language as is the case when comprehension is a problem. An interesting observation in Setati et al.’s study is that, where one teacher translated mathematics word problems including mathematical terms into the learners’ local languages, the learners found the terms harder to understand than when presented in English. Although it can be argued that it might have been the teacher’s translation that was problematic, the point is that it was not easy to provide a translation that learners could understand (Kezami).

The language of instruction in Nigerian secondary schools is English cannot be overlooked because it is a second language in which the students are currently learning mathematics and other subjects in school (David, 2011). To be good in
mathematics requires adequate grasp of definitions and technical meaning of mathematical words, terms, and symbols for better understanding and improved performance in mathematics (Olanipekun & Ishola, 2014). Adetula’s (1989) insupport of this argument in his study concerning Nigerian Primary 4 public and private school students, found that students performance from private schools were much better than those from public schools. This finding is to be expected since the students in the public schools would have experienced only one year of instruction in English and therefore, would have had limited English proficiency.

Indigenous languages in Nigeria do not possess all terminologies that are relevant in explaining some new concepts in learning mathematics (David, 2011). Formulating mathematical modelling as a strategy in the mathematics classroom, where the language of instruction is English language of instruction is the best strategy to enhance learners performance in the Nigerian secondary school mathematic (Omobude, 2014). Adegoke (2013) on structural egression modelling of bilingualism and achievement in mathematics among senior secondary school students in Nigeria showed that the relationship between Proficiency in English language and mathematics achievement was high and positive.

Students’ proficiency in English language increases, achievement in mathematics is also likely to increase. This indicates that linguistic needs is a critical issue in our schools and, consequently, for educational research, policy and practice. These findings support the findings of the earlier researchers (e.g. Adegoke, 2010; Adegoke & Ibode, 2007; Fakeye & Ogunsiji, 2009; Mosqueda & Téllez, 2008).
who found that in countries where English Language has been adopted as the official language in place of their original indigenous language, students’ low level of achievement in mathematics may not be unconnected with their proficiency level in English Language. Therefore, if a student is proficient in English language, it more likely that he or she will perform well in mathematics and vice versa. It is pertinent to embark on a research of this nature to investigate on the difficulties associated with word problem.

2.4 Effects of English Language on Mathematical Modelling and Achievement

Learning mathematics in a language that is not in the learner’s native or main language is a complex process that develops in one’s understanding of the subject. During the period of learning mathematics in a multilingual classroom, there is always a salient period on part of Limited English Proficiency (LEP) students and a careful presentation on part of teachers; this is because the concentration is on comprehension and response using non-verbal means of communication (Krashen, 1985). Setati, Chiton & Essien, (2009) on multilingualism in mathematics secondary education in South Africa found that students’ knowledge of the subject matter which is learnt not in their first language has a serious effect on their achievement in mathematics. Yet with increased exposure to the English language, the Limited English Proficiency (LEP) students can progress through several additional stages of language acquisition. The most important stages which are important to mathematics and
are relevant to LEPIs reading and comprehension stages. Learners can receive message through reading and comprehension (Kazima, 2008).

Breen & Oshen (2010) refer to reading and comprehension as mathematical modelling task which should be built on students’ previous knowledge and which are capable of being represented in multiple ways, when generated particularly on word problem task. A proficient student is one who can solve real world problems by applying mathematical concepts such as identifying important quantities, making appropriate assumptions, and selecting a viable model for finding a solution (Oswalt, 2012). The student should then be able to interpret the results within the context of the problem and make revisions (if necessary) to the model before reaching a final evaluation (Tall, 2008). Students’ ability to model and solve word problems successfully will improve in their achievement in mathematics (Zbiek & Conner, 2006). In this direction, the new Common Core State Standards in Mathematics call for a greater emphasis on mathematical modeling as students’ would be assessed on their ability to solve a variety of open-ended problem types (CCSSM, 2010).

Sua (2007) in his research on problems and challenges in learning mathematics and science through a second language among Malaysian students found that performance of students who are learning mathematics through a second language have become a matter of concern among the education stakeholders. This challenge is not only viewed in mathematics but also in science subject where the medium of instruction is in second language (IRC, 2008). The magnitude of this
challenge becomes very high as it involves cognitive-academic language proficiency (CALP). Majority of Malaysian students especially at the lower basic of education lack high levels of English proficiency that can enable them to study science and mathematics effectively (Sua, 2007).

The assumption was that, since most of children attended play class, they would have at best only acquired the basic interpersonal communicative skill (BICS) in English in such a short time span. Because of low proficiency in English among Malaysian teachers and students, the need to produce teachers with proficiency in the language of medium require many skills and efforts, since is not just to know the concepts but to impact it to learners (Sharifah, 2004). This is clear evidence as most teachers in multilingual mathematics classroom do not possess the basic competency in teaching mathematics and science in the learners’ second language and this affect learners performance (Hafriza, 2006). However in Singapore, students’ mathematics achievement was among the top in the list as indicated in the international assessment studies for secondary mathematics such as TIMMS and PISA (Mullis et al., 2012, OECD 2010) and the expectation was that, modeling procedures were included in the mathematics curriculum (OECD 2010).

Ogechi (2009) in her findings on the effect of second language and first language on students’ performance at the lower basic of education in Kenya, revealed that because of the complexity between the two languages, learners who are in their fourth year in the primary school have problem of communication especially in
the language of instruction. In essence, they lack the basic skills to communicate in the language of instruction during mathematics lessons especially at the middle school and at the senior secondary level of education.

The Kenya National Examinations Council's annual newsletters show that many candidates for the Kenya Certificate of Primary Examination fail to answer questions due to their inability to understand what is asked, i.e., due to a poor command of English (KNEC, 2008). Kenya Certificate of Primary Education (KCPE) is used to select form one students to various cadres of secondary schools on the premise that their performance in KCPE will affect their performance in KCSE which comes at the end of secondary education. Kenya’s education system is such that one takes examinations after 8 years of primary education. Adriaan (2008) posits that many of the performance problems at secondary school level have their roots from primary school level. This is because few countries have effective strategies for teaching languages to pupils who enter primary schools. This poses a challenge because English is the medium of instruction and plays a key role in understanding the content of any subject taught in the curriculum.

The National Center for Research on Evaluation, Standards, and Student Testing (NCRESST) on the influence of learner’s language ability, found that learners’ language ability determine their achievement in learning new concept in mathematics and science subjects. The text language in the task may affect its appropriateness and its acceptability. This is common among second language learners (Abedi & Lord, 2001). This is a clear indication that students’
performance in mathematics depends on the knowledge of the medium of instruction.

Similar research on the relationship between bilingualism and mathematics performance among junior secondary school students in the south western part of Nigeria found that, the performance students who are from private schools was very high compared to students from public schools. The belief where was that, those students with high score have high proficiency in English and have receive early teaching of mathematics in English language compare to those in public schools (Ladele, 2013). These indicate that linguistic needs is a critical issue in our schools and, consequently, for educational research, policy and practice (Adegoke, 2013).

This agrees with the findings of the previous researchers(e.g. Adegoke, 2010; Adegoke & Ibode, 2007; Fakeye and Ogunsiji, 2009; Mosqueda & Téllez, 2008) who found that in countries where English language has been adopted as the official language in place of their original indigenous language, students’ low level of achievement in mathematics may not be unconnected with their proficiency level in English language. Therefore, if a student is proficient in English language, it is more likely that he or she will perform well in mathematics and vice versa. This agreed with the findings of Clarkson and Galbraith (1992); Adegoke&Ibode, (2007); Moschkovich, (1996) linking language and mathematic achievement.
In Nigeria, curriculum of secondary school subjects is normally prepared by the Nigeria Educational and Research Development Council (NERDC, 2007). The mathematics curriculum as prepared by (NERDC) consists of four major sections. These are Number and Numerations, Algebra, Geometry and Statistics and they are the fundamental concepts of mathematics. Students’ achievement in mathematics is the extent to which they are able to master these fundamental concepts of mathematics. English Language curriculum also shows three major sections. These are comprehension, grammar, and Lexis and Structure. Students’ proficiency in English language is the extent to which they are able to master these fundamental concepts of mathematics and in particular word problems.

The students’ performance at the external examination (SSCE) in mathematics in 2014 has revealed poor achievement of students in the subject. Result indicated that less than forty percent (40%) of students out of the total number of those who sat for examination scored five credit and above in Mathematics and English language. Similar performance was observed in the pass years 2010, 2011, 2012, and 2013 (Musa & Dauda, 2014). These low achievements in the subject have become a matter of concern among the Nigerian educational stakeholders.

Jadie, Sonya, Laura & Natasha (2012) viewed that low proficiency has been considered a barrier to learning and academic success at the post-secondary level and this is because English learners often lack the language proficiency necessary to understand the test content and academic work. Olanipekun&Shola (2014) in a study on proficiency in English language as a factor contributing to competency
in Mathematics of primary school pupils found that students’ proficiency in English language has been discovered to be a contributing factor to good or poor performance.

Joseph & Kurumeh (2011) in their study on the effect of two Problem-solving Models on Junior Secondary School Students’ Achievement in algebraic word problems submitted that student poor achievement of Nigerian students in mathematics is mostly to teaching approaches adopted by mathematics teachers in presenting instruction. Most teachers adopt the conventional approach in the teaching of mathematics where the focus is on what is being taught rather than who is being taught and as such, it is a teacher or subject – centered approach. A number of problem-solving models have been developed by some researchers to enhance students’ performance in mathematics and particularly word problems, yet students’ achievement in word problems in mathematics is still very discouraging. It is in the realization of this that the researcher decided to conduct a research using mathematical modelling approach and the motives behind it that this could offer solutions to the students’ level of mathematical abstractions, which is predominant in algebraic word problems.

2.5 Mathematical Modelling and Gender Performance in Mathematics

An important component of effective teaching mathematics is to know the best strategy that can provide the picture about students’ performance, irrespective of their differences as this would help the teacher carry all leaners along (NCTM, 2012). Performance in mathematics is all about doing and learning mathematics.
Doing mathematics is modelling which is defined as the process of finding a mathematical model that best reproduces the data obtained in the study of a phenomenon or situation from any field of knowledge or daily life (Flores, 2010). Although mathematical modelling is believed to enhance mathematics performance generally, the vision of mathematics reform is that high academic standards must be applied to all students (males and females) in the mathematics classroom (NCTM, 2012, Arhin & Offoe, 2015).

In Nigeria, there is a general belief that males are good in solving difficult and abstract problems than their females’ counterparts. Mathematics is a field of study that to some extent is abstract in nature and this requires one’s critical thinking in learning a particular mathematical task. In essence therefore, males’ students can perform better than female students and are referred to as good problem solvers (Ekeh, 2003). These differences in performance can be attributed to the proficiency of language of instruction, the learning strategies and tasks that are required in learning the subject. These discourage male and female students to show interest in subjects relevant and even failed to relate the roles expected of them in the society.

Joseph & Kurumeh (2011) on their study on the effect of two Problem-solving Models on the Nigerian Junior Secondary School Students’ Achievement in algebraic word problems for both experimental and control groups showed that both male and female students in the two experimental groups achieved significantly higher than those in the control groups. The result further indicated
that, female students in both Greeno and Metes et al., problem-solving models had higher mean scores than their male counterparts. From these findings, it was observed that differences existed in the achievement of male and female students but yet their performance levels in algebra increased significantly. Contrary to this findings were that of Njoroge& Githua (2013) which in their study on effects of Cooperative Learning/Teaching Strategy on Learners’ Mathematics Achievement By Gender found that there no there are no gender differences in students’ mathematics achievement when students are taught using cooperative learning/teaching strategy.

Adeleke (2007) in his study on gender disparity in mathematical performance found that no significant difference in performances exists between male and female students when exposed to both Conceptual Learning Strategy (CLS) and Procedural Learning Strategy (PLS). Thus the study has revealed that students’ performance in mathematics is not sensitive to gender. These differences are as a result of the relative effective of Conceptual and Procedural Learning Strategies and not as a result of gender. The learning strategy adopted by the teacher must ensure maximum participation of the student, proceed from concrete to abstraction and provide knowledge at their understanding level (Merchant, 2010). Mathematical modelling is an approach that assumes there is a diversity of learners in every classroom and that all learners can be reached if the language of instruction is clearly used. Mathematical modelling is a way of diagnosing the needs of individual students and making accommodations in the classroom to
meet their needs. All students are not alike, that is, students learn in different ways and at different rates.

As discussed earlier, one of the basic requirements of modelling in word problems is to enhance students’ problem solving ability and increase their proficiency of the language of instruction, all these constitute knowledge. For instance, mathematical modelling enables learners to recognize, identify, explain, evaluate, judge, create, invent, compare and choose when dealing with mathematical facts and concepts. These enable learners to apply skills in a routine manner with fluency.

The society is tending towards assuming unified challenges for both male and female. There is therefore the need to give equal opportunities to both male and female to enable them develop the necessary required skills and capabilities to face the challenges. There is the need to identify the status of differences in boys and girls at junior secondary level in mathematical problem solving so as to make for closing the gap, if any, is imperative.

2.6 Mathematical Modelling and Learning Strategy (Problem Solving)

The motives behind the study of any mathematical strategy at any level of education are to acquire the knowledge and use it to solve related problems. Mathematical modelling is a procedure that is based on knowledge building as it involves series of steps which is required by learners to follow (Flores, 2010, p.78). These are more than just getting solution to the existing problem as it entails
explanations and interpretation of the problem situation. (Lesh & Zawojewski, 2007). In support of this assertion, Lesh & Sriraman (2005) viewed modeling process as one of the important area that seeks the attention of stakeholders in improving students’ achievement in mathematics.

Because of its sensitive position as an important strategy in improving learners proficiency of the text language and the language of instruction, mathematical modelling is currently receiving attention by many researchers in the field of mathematics education (Breen, 2010 & Oswalt, 2012). This is because, many experts and researchers today are concerned on how prepared and ready are learners in acquiring this new approach in learning mathematics and particularly algebraic word problems. English, (2003), Mousoulides, Sriraman, & Christou, (2007) viewed that, students can only function effectively when they can comprehend and formulate an idea to solve related problems and for learners to be good problem solvers, they must prepare and have the in-depth knowledge of the existing situation and this can only be possible when engage in modelling process (Lesh & Doerr, 2003).

Lesh & Zawogewski (2007) viewed modeling approach in a problem solving situation as an approach that concern with the explanation of the existing data and goals as major requirements that are needed in getting solution to the problem. The interpretation or explanations that are involve in the problem leads to the formation or development of an equation that can process data and students using the equation can operate and produce good solution to the problem (Forsten, 2010).
In Singapore, a research on mathematical modelling has been carried out with children in the middle school (Eric, 2009). Just as it has been found from research overseas that, children were capable of developing their own models and sense-making systems in complex problem situations (English & Watters, 2005; Lehrer & Schauble, 2000). Research has also indicated that mathematical modelling help to displayed learners abilities in identifying goals and variables, interpreting problem situation, interrogating data, inquiring and self-monitoring, improve conceptualizations, and extending their thinking during mathematical modelling (Chan, 2008). Mathematical modelling gives the learners the opportunity to learn many representation of information, they would be able to select correct and relevant data and formulate an equation which serves as tools in solving word problems (SME 2007, p.4). Besides problem solving, this provides Singapore teachers with an alternative instruction method to teach mathematics using real life problems ((CCSSM, 2010).

Eu (2013) in his study on mathematical modelling in the Malaysian secondary curriculum viewed that the approach might not be as simple as a normal problem solving approach developed by other researchers. Mathematical modelling in word problem situation requires adequate mathematical knowledge to do the model (equation) and get the correct solution. When the word model is mentioned, the first thing that comes to our mind is the image of a physical entity (Eu, 2013). He further viewed mathematical modelling approach in a real world context to include procedures such; Observation, Analysis, Interpretation and Application.
In Nigeria, a number of problem-solving models have been developed by some researchers (Abiodun 2005 & Ladele, 2013) to enhance the problem-solving skills and abilities in the area of mathematics with particular emphasis on algebraic words problems, yet students’ performance in General mathematics and algebraic word problem is still poor. In the realization of students poor in the subject, the review of junior secondary mathematics curriculum (JSMC, 2014) states that ‘teaching and learning mathematical modelling should be part of the learning for all levels’ and defines it as “the process of formulating and improving a mathematical skill to represent and solve real-world problem (FMoE, 2007: 14). The needs become necessary as the junior secondary school mathematics curriculum is the linkage between primary and senior secondary school mathematics syllabus (JSSMS, 2007). These new inclusions are by no means a minor extension to the curriculum.

In Nigeria, no known research on mathematical modeling on algebraic word problem has been carried out at junior secondary school students. Interest for this research is triggered by the researchers concern about students’ poor academic performance in General mathematics and algebraic word problem. Difficulties in learning algebraic word problems may arise from the language of the problem, generalizations involved and the use of letters to change to mathematics (equation) which differ from everyday use that students know (Joseph & Kurumeh, 2011). The language of instruction at which the students learnt algebraic word problem is also a matter of concern to the researcher. Against this
background therefore the researcher wish to find out if the use of mathematical modeling approach would make word problems easier solve by Nigerian junior secondary schools students.

2.7 Mathematical modelling in Word Problems and Newsman Performance Strategies

The level of proficiency in the text language and the language of communication may also affect performance in word problems, where the language of instruction is in the second language (Olanipekun & Shola, 2014). This is of particular importance, of course, to the Nigerian context. In support of this, Yeo (2009) opines that learners find it difficult to solve some related algebraic word problems as a result of their failure to comprehend the text language which are English written statement and as result leaners of mathematics becomes frustrated and tend to develop phobia in learning the subject.

Suggested teaching strategies include explicit instruction about the differences in the everyday mathematical meaning. The use of student collaboration, encourage students’ use of new words mathematically within real-life contexts, and the use of multiple representation (Kersaint et al., 2009). Mathematical modelling approach provide prompts to facilitate students’ development of literacy in mathematics and subsequently should increase their proficiency level of solving word problems..
English (2003) viewed that mathematical modelling occupies a central place in implementing any school mathematic curriculum especially at middle level of education. Since those aspect of modeling are to explain and interpret the existence of a problem situation, thereby making leaners to create and develop ideas to solve related problems. As leaners engage in modeling process, they are likely to communicate with the data in given problem and solve the problem as well (Oswalt, 2012). In essence they can examined, evaluate and paraphrase or refined the problem thereby by developing an equation or algebra to solve the problem. (Lesh & Zawojewski, 2007, p. 785). The mentioned procedures are refers to as Mathematical Modeling Procedures and are relevant in solving word problems. These are as follows;

Step 1-Reading process

At this step, the teacher reads the stated problem to the attentive students as they are about to work on the problem. The teacher makes the students read the question clearly as these will arouse their interest. Students already have the knowledge of algebraic problems in their first year.

Step 2 Comprehension process

At this step, teachers explain some key words in the problem and relate them to relevant operation in the problem. These words may include; whole (complete or total number or object), carried away (decrease or minus).

Step 3- Mental representation
This can be done by bringing or setting the problem in a more familiar way to the students, such that; the whole is represented and change is effected in order to get the remaining value.

Step 4 – Transformation process

At this step, the teacher translates the word problem into mathematical statement to represent the real life situation; this can be done by setting the numerical value and the unknown value. This makes the problem to be transformed into mathematical statement for easy comprehension.

Step 5 – Process skills

The correct transformation of the problem into mathematical statement enables the teacher help the student select the correct operation that is required to solve the given problem by using the identified variable.

Step 6– Encoding or reviewing process

The teacher tests the solution especially at the process skills to see whether the solution has agreed with the stated problem. This means that the difference between the unknown and the reduction always gives the value of the original. The approach agreed with the Newman performance strategies. This procedure identifies errors made by students as they solve word problems. Newman (1983) established an interview protocol consisting of five questions, which has the intention of identifying problem solving difficulties of students in mathematics. The interview is conducted after the student has attempted to solve the problem and failed to generate a correct solution. Children may find it difficult to solve
word problems because they have to process the language of the text before they embark on solving the question (Pimm, 1991).

In a study of the patterns of 124 low achieving Grade 6 pupils as they solved mathematical questions given to them, Newman (1977) reported that 13%, 22% and 12% of the pupils had reading, comprehension and transformation errors respectively on the questions. She identified that errors could occur at each procedural step, and classified these into five main categories which are briefly described as follows; (1) Reading recognition which involves recognition of both the words and symbols in the given task. Reading error would affect the process of answering the question. (2) Comprehension, a step which entails students showing an understanding of specific terms and saying the questions in their own words. Their abilities to extract the core issues in a question. If they cannot paraphrase what the question is about, they are unable to move any further and this is called a comprehension error. (3) Transformation which requires a word problem written in a mathematical form. The understanding derived from the question which is in a literal form and now has to be transformed into other suitable and correct representations, depending on the requirements of the task solve the question in algebra. If an individual is unable to identify the needed operation(s) it is called a transformation error. (4) Process skills depending on the new representation form, the arithmetical operations and computations needed to process the question are carried out. If a person does not know, guesses, uses the wrong operations, calculations or procedures, it is termed a process skill error. (5)
Encoding ability where the learner writes or verified the solution obtained. If a student is unable to write the answer in a form which is acceptable, it is called an encoding error.

2.8 Improving Knowledge of Mathematics through Mathematical Modelling Approach

Mathematical modeling approach includes reading, defining, selection, transformation, forming, solving, refining and encoding. These are stages or pre-activities needed in leaning a particular mathematical task. Modelling activities are aimed at helping learners contextualize the problem solving situation and develop processes and ideas in finding solution to the problems (Lesh et al., 2003). Modelling is viewed as mathematical patterns and the development of such patterns. These require a series of thinking and analysis in solving the existence problem. These approach does not only seek to get solution to the problem but gives a clear picture on the existence of the problem. (Schorr & Amit, 2005; Lesh et al., 2003).

Current research in mathematics education is demonstrating that young learners can benefit from working with authentic modelling problems (English & Watters, 2005). In particular, it has been argued that modelling activities can help students to build on their existing understandings, to engage in thought-provoking, multifaceted problems within the contexts that allow for multiple interpretations and different approaches (Schorr & Amit, 2005; Doerr & English, 2003). Mathematical modelling also gives the students or learners the ability to connect
chain of experiences (steps) to get an accurate result about a task, by so doing it makes them build on the existing knowledge (English and Watters, 2003). English (2003) viewed that when students employ modeling activities in solving mathematical task and particularly algebraic word problem, they would be able to work confidently and meaningful, they would also be able to show relationship between variables or symbols in the task, explain the meaning of such symbols and use them develop an idea or mathematical statement to represent the real life situation.

The National Council of Teachers of Mathematics (NCTM, 2009) viewed that, most schools mathematics task (secondary mathematics syllabus) does not provide an opportunity for learners to develop, refine or make representation that can explain the problem situation. In essence therefore, mathematics learning materials are to reflect with the new changes so as to make learners acquire relevant and good knowledge in order to adopt with new approach in learning mathematics.

The Trends in International Mathematics and Science Study report for the 2011 survey identified that algebra word problems generally presented the most difficult content for Grade 8 students (lower secondary level students) and that they only demonstrated a 37% facility in this area (TIMSS, 2012). Studies showed that this transition is difficult because of the students level of background of the language of the text and the need to use variables, most often seen as letters, in arithmetical operations (Goldin, 2008). In this regard therefore, modelling a
problem would enable students to be able to “interpret, construct and operate” effectively using a developed or representational formats. This is followed by the need for the use of computations and arithmetic skills on the generated format so as to arrive at a solution.

Mousoulides, Christon & Srirman (2008) conduct a research on tracing Students’ Modeling Processes in School conducted in Cyprus (examining similarities and differences between 6th and 8th grade students’ as they worked on a mathematical modeling process on real word problems. The notion was to find out the similarities and differences between 6th ((12 girls and 7 boys) and 8th grade (10 girls and 8 boys) years old on their modeling procedures. The two grades were choosing as intact classes for the test. The activity is a modified version of the “Summer Jobs” activity (Lesh & Doerr, 2003). Students in both classes had prior experience in working with modelling activities as they were in their second year in lower secondary level of education (Mousoulides, 2007).

During the test, the modeling processes appeared in students’ work, and were presented for each group with regard to the steps of the modeling procedures such as; description, manipulation, prediction of the problem, and solution verification (Lesh & Doerr, 2003). Students worked for four 40 minute sessions to find a solution for the problem presented in the activity. Result indicated that 6th graders failed to fully understand the problem; they understood the core question of the problem but they did not succeed in connecting the core question with the provided data. On the contrary, 8th students identified the necessary variables and
relationships to describe and understand the problem and made connections through verification of their solutions to the problems. A notable difference between 6th and 8th graders was from the perspective of communication and evaluation. Although students in both groups adequately communicated their ideas and solutions. Teachers therefore can assist students comprehend and develop confidence when faced with any mathematical problem and this will increase their computational skills or abilities.

Modelling process is not only viewed as a strategy to enhance students’ performance in mathematics but is an acceptable strategy that encourage interaction between teachers and students in the mathematics classroom, these happens as there is communication when learning the new concept. The Common Core Standard (CSS,2010: 72) viewed modeling process as a process of selecting and utilizing relevant algebra with figures to make interpretation on a situation that exist as a problem. Modelling is also viewed as an approach that entails detail study of a given problem as it provide the leaner with the ability to explain, create, formulate and relate relevant data to obtain solution from a given problem. The notion in modelling process especially in learning algebraic word problem is to develop an education or an algebra that can give sense to problem situation in which the current learning process (problem solving strategy ) is lacking as it fails to interpret and spell out the goals and givens of an existing problem (Him&Kim, 2011).
In Nigeria, the new national mathematics curriculum for primary and junior secondary schools in Nigeria is focused on giving the children the opportunity to acquire mathematical literacy to function in an information age and cultivate understanding of the skills necessary for the changing technical world (Cecilia, Anne & Nnenna, 2013). According to Ekwueme & Meremukwu (2010), the current curriculum tries to make mathematics more of real life than abstract concept. This means that attempts are being made to introduce the concept of modelling into the new curriculum.

Omobude (2014) on his study on learning mathematics among the Nigerian secondary school students through mathematical modeling viewed that mathematical modelling may have the potential of being valuable with respect to the learning of secondary school mathematics. This is because, in the study, the observed students seemed to be motivated by the nature of the connections between classroom mathematics and real-life. Also, the case of non-abstractness of secondary school mathematics was showed. Some of the observed students affirmed that they never knew mathematics could be so real like the modelling problems they worked with. For example, some of the observed students said that they never imagined the car park problem could in any way be related to angles.

However, despite the fact that the new mathematics curriculum in Nigeria secondary school seems to have some inbuilt elements of mathematical modelling, no such modelling activities or problems could be found in the various
textbooks that are mainly used in the teaching and learning process at this level of education (Omobude 2014, p.71).

Esan (2015) in his study on Students’ Learning Outcomes in Algebraic Word Problems using the Poly approach viewed that mathematization in word problems makes leaners model the problem to represent the real life situation. He maintained models can represent quantities and operations with quantities. In the Polya Problem solving approach which includes four steps such as, defining the problem, transformation, solving and encoding, Esan (2015) found that between students of experimental group who were taught have a significance increased in performance than student control groups. Solving algebraic word problems is more than just the definition and the solution as it involves series of which gives a learner the ability to express and elaborate themselves. Since the Language of instruction in Nigerian secondary English language, therefore to study algebraic word problems, a thorough understanding of the language is very important.

2.9 Pedagogical Content Knowledge (PCK) in Mathematical Modelling Instruction

The inclusion of mathematical modelling approach within current Nigerian Junior Secondary School Mathematics Curriculum structurerequires a major paradigm shift in teachers, who must adopt new approaches and new roles to such mathematical modeling instruction, as well as the acquisition of new knowledge (NPE.2007, Peter & Olaoye, 2014). To implement such innovations (mathematical modelling instructions) successfully, teachers therefore are require
to have the requisite knowledge in mathematical modeling instruction that provides a basis for classroom practices. Pedagogical Content Knowledge (PCK) is a knowledge that shows how a teacher can teach the subject content and the language of mathematics (Binda, 2005). Ball, Thomson & Phelps (2008) posited that the knowledge of mathematics teaching can be viewed in terms of the knowledge of content and students and the knowledge of content and teaching.

Pedagogical proficiency enables the teacher to have the knowledge of all aspects of the subject matter. These prepare him to plan and use relevant technique and instructional materials to teach the new mathematical concept. The pedagogical does not only make the teacher master the content but enable him or her to have the knowledge of his learners, particularly their level of learning a new task. In doing so, the teacher introduces a new mathematical concepts base on learners’ level of understanding (Bio, 2011). Shulman (1987) in his study opines that teachers’ proficiency of the subject matter and the methods to be use in learning a new task may not be for a mathematics teacher to be a mastery of his work but that pedagogy makes the learner be influence and develop interest in learning a new task.

The teachers’ proficiency of the language use in teaching the mathematics context (word problem) is a necessary step towards the teaching and learning of the appropriate modelling (Aegoke, 2013). To achieve such changes, teachers would need to be trained to learn to know how to teach mathematical modeling (Shulman, 1986). Such learning for teaching approach requires a more adaptive style of instruction in which teachers understand the connections of mathematical
ideas in these tasks, and adjust their pedagogical strategies to augment the implementation of these tasks. Even though secondary mathematic teachers have access to materials and resources in the form of booklets containing collections of modelling and application activities.

Lack of knowledge in mathematical modelling instruction may inhibit novice teachers from structuring and engaging students with meaningful and effective mathematical modelling learning experiences (Shulman, 1986, Ball, 2000, Ang, 2009. Gabraith, 2006). In Nigeria, the scenario is different and as the study relates to Nigerian context, no meaningful research has ever been done in this area of study. The only related study that was done was on visual models on algebra (geometry word problems) among senior secondary schools in Nigeria (Ladele, 2013). Against this background, the contribution of this study would provide teachers with good and simple modelling procedure in solution to word problems. Since words problems are linguistics in nature, teachers in Bauchi State-Nigeria would have a bases for addressing second language learners’ problems in mathematics

2.10 Views/Arguments on Second Language and Performance in Mathematics

Despite the fact that mathematics is a universal and general field of study which touches all aspect of human endeavor, where the teaching and learning have to commence in common language and only to change to another, controversies and arguments continuo to exist on the type of language of instruction. Mathematics is
not limited to performing computations in isolation; it is dependent on the English language.

Garegae (2008) in his study found that all learners can face difficulties in learning mathematical concepts as a result of the text language. He further stated that mathematics involve variables and some registers (group of words) which need to be learnt and understood by leaners. The variables are the mathematical language and the registers are English written word with meanings. These two aspects of mathematics becomes second language to learners whose language differs from the medium of instruction. In view of this, teachers need to assist all leaners learnt and related these two important aspects in learning mathematics.

Thompson (2008) in support of this views maintained that students or learners who are learning mathematics in their second language can perform better just as if the learning is in their first language. She further stated that to assist second language learners, teachers of mathematics and particularly algebraic word problems should include communication, discussion, reading and interaction with learners in solving a task through mathematical modelling, Thompson stated leaners should be involve in the learning processes. She further mention that other ways of helping second language learners perform better in mathematics is to organize extra lesson and remedial lesson. Thompson (2008) realizes this dream as she piloted a test on both the second language and first language learners. Her result indicated that even the English speaking learners were found struggle with the task and has therefore recorded low performance in the test.
Adegoke (2010) in support of the above assertion found that, students’ performance in mathematics is unconnected with their proficiency level of the language of instruction, by this, both second language learners and first language learners struggle in learning any mathematical concept. In contrary to this findings were the findings of Setati, Chitera & Essien (2009) who were of the views that, even though most African indigenous languages lack some mathematical terminologies yet learners can perform better in mathematics through code-switching.

In the New Zealand, Latu (2008) in her research on proficiency of the medium of instruction on students’ performance in learning mathematics found that, students who were learning mathematics not in their first language but in a second language faced many challenges in comprehending of some mathematical symbols and variables. However the research further revealed that some students were found to perform better in those questions that involve only vocabulary that does not seek any computation or formation of mathematical equation in getting solution to the problem. Also when they were given word problems that required them to read question or statement, think, analyze, and carry out appropriate computations, most students did not have the appropriate problem-solving strategies.
Students need to be strong in both their general language of instruction and mathematical language. These combine would provide the comprehension skills needed which can make sense and solve mathematical word problems (Aegoke, 2013). If their mathematical background is poor at the secondary level, it does not matter what language we test them, either in their mother tongue or in English – either the relational understanding has not been laid down or there is a combination of poor English ability and undeveloped mathematical discourse in their mother tongue (Thomsom, 2008 & Aegoke 2010). It is our belief that it is more of a problem with their mathematics problem solving abilities rather than the language of instruction.

Present development leads to interaction among many communities of the world. This is because the world today is becoming a multilingual community. Children and adults who, for personal, athletics, academic and economic reasons, are becoming multilingual. There are a number of advantages of being exposed to a second language, including cognitive advantages that can arise from achieving a particular level of proficiency in a second language especially in Nigeria and Bauchi state in particular. It is a fact that there are more bilingual brains on the planet than monolingual ones, so the teaching and learning of mathematics at the secondary level of education has to commence in an acceptable and recommended language. There are a lot of benefits in learning mathematics through a second language as these would facilitate the growth of science and technology globally.
2.11 Summary

The review of literature on the influence of English as a second language in teaching and learning of mathematical modeling was carried out based on teaching policy, mathematical modeling and the second language proficiency, Influence of Second Language on Mathematical modeling and Achievement, Gender and academic performance in mathematics, mathematical modeling and learning strategies, gender and students achievement in mathematics, mathematical modeling in word problems and Newsman performance strategies, improving knowledge of mathematics through mathematical modelling, Pedagogical Content Knowledge (PCK) in Mathematical modeling. Also Views/Arguments on Second Language and Performance in Mathematics were discussed in the study. The following were highlighted, justified and gaps were observed and identified in the course of teaching and learning mathematics;

i) A lot of researches have been carried out on the effects of English language in other subjects other than mathematics. In Nigeria, there is hardly any investigation carried out on effects of English language on students’ performance on teaching and learning mathematical modeling at junior secondary school level.

ii) A lot of literature focuses on the importance of mathematical modeling rather than showing how the procedure can be carried out particularly at the junior secondary schools in Nigeria and hardly found any teacher using a defined modelling approach in teaching algebraic word problem.
iii) Research has shown that difficulties in learning algebraic word problems may arise from the language of the problem, generalizations involved and the use of letters to change to mathematics (equation) which differ from everyday use that students know. This may lead to poor performance in the subject; this also has not been fully addressed.

iv) In Nigeria there is no established or published research on mathematical modeling in the second Languagelearners’ mathematics classroom at the junior secondary level of education.

v) Research indicates that most Nigerian school mathematics problems being posed to students do not involve the students in creating, modifying or extending systems of representations for meaningful problem situations. Even in solving typical textbook “word problems,” students generally try to make meaning out of questions that are often simply a thin layer of words disguising an already carefully quantified situation. This remains a constant problem especially in solution to word problems among Nigerian junior secondary schools.

vi) Above all, research has indicated that the effect of English language on students’ performance in mathematics is related to other variables such as students’ gender, age, background and attitudes. These have not been fully addressed particularly on mathematical modelling of algebraic word problems among Nigerian junior secondary schools.
CHAPTER THREE

METHODOLOGY

3.0 Introduction
This study explored the effects of English language in teaching and learning of algebra word problems in Nigerian secondary schools and in particular at junior secondary level of education. In doing so, teachers’ proficiency of English, classroom practices for teaching word problems, and the students’ approach in solving word problems were assessed. The effect of the treatment on learners’ success in algebraic word problems was then investigated.

This chapter discussion details the method used to accomplish the study and is organized into sections. The sections describe, in order, the research design, the variables, the target population, the study location, sampling techniques and sampling size used in the study. Also included are descriptions about the piloting: validity and reliability of instrumentation. Data collection, analysis of data, legal and ethical considerations, and summary.

3.1 Research Design
A research design refers to the specific techniques and approaches applied in a research study to answer research hypotheses and or research questions (Privitera, 2014). In this study data were obtained both from quantitative and qualitative approaches. This mix of approaches complements the limitations of any one method, and findings are strengthened when using different approach results in the
same findings (Cohen, Manion, & Morrison, 2011). When both quantitative and qualitative data are involved in a study, they are also referred to as embedded research design. This is a design that take into consideration both numerical and non-numerical responses obtained from the sample under study. The essence of using these two kinds of responses (quantitative and qualitative) in a study is to ensure the credibility, quality and the originality of responses concerning the phenomena under study, also one aspect of the responses will serve as a supportive data in the study (Creswell & Plano, 2011). By implication, the responses obtained from the two approaches would assist the researcher in getting the in-depth study variable under study that concerned the respondents.

A qualitative approach research is focused on people within their natural settings and uses gathered information to build a full picture of the unique situation (Anderson & Arsenault, 1998; Silverman, 2011). To build this picture, classroom observations, semi-structured interviews with students, and focus group discussions with teachers were employed. Quantitative approaches, on the other hand, use measured outcomes with numeric values to evaluate the impact of an intervention (Creswell, 1994). In this approach quasi-experimental design was used to obtain the outcomes from the students’ mathematics word problem solving test completed before and after the intervention.

Creswell (2009) opines that Quasi-experimental design and in particular Solomon Four-Group design require the researcher used two controlled and two experimental groups but does not randomly assign participants to groups. A pre-
test and post-test was administered to both groups, but only the experimental group received treatment. The design allowed for a rich analysis and description of the effect of the treatment on teachers and students.

Solomon Four-Group is the most powerful design. It allows increase in generalization about the findings, the effect of treatment X is reflected in four different fashions as compared to other experimental designs (Ogunniyi, 1992). The design provided the researcher with confidence about the results obtained from the study. This is because it controls both threats of internal and external validity. Solomon Four-Group provides the researcher with the ability to ensure an in-depth study on variables under study. This means that it shows whether changes can occur in the study variable. It identifies a comparison group that is as similar as possible to the treatment group in terms of baseline (pre-intervention) characteristics. In essence it controls any extraneous factors that are likely to affect the result. It also ensures that the result of the pre-test do not influence the result in the post-test (Shuttleworth, 2009). Table 3.1 present the design.

**Table 3.1: Solomon Four Group Design**

<table>
<thead>
<tr>
<th>Group</th>
<th>Pretest</th>
<th>Treatment</th>
<th>Posttest</th>
</tr>
</thead>
<tbody>
<tr>
<td>R</td>
<td>E1 O1</td>
<td>X1</td>
<td>O2</td>
</tr>
<tr>
<td>R</td>
<td>C1O3</td>
<td></td>
<td>O4</td>
</tr>
<tr>
<td>R</td>
<td>E2X2</td>
<td></td>
<td>O5</td>
</tr>
<tr>
<td>R</td>
<td>C2O6</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note. 0 = outcome measure; X= treatment; R = randomization

**Source** (Braver and Braver 1988).
Table 3.1 shows how the experiment using the design was applied. It was carried out in such a way that Group E1 (Experimental group) has received pre-test (O1), treatment (X) and post-test (O2). Group C1 (Control group) have received pre-test (O3), no treatment and post-test (O4). Group E2 have received no pretest but have received treatment (X) and post-test (O5). Group C2 have received only post-test (O6). The post-test O5 and O6 have ruled out any interaction between testing and treatment. Within each treatment condition, there was a group that was pretested (E1) and the one that was not (E2). The various combinations of tested and untested groups with treatment and control groups will allow the researcher to ensure that confounding variables and extraneous factors have not influenced the results (Spector, 1981).

3.2. Research Variables

3.2.1 The Independent Variables

The Independent variable used in the study was English language, the language of instruction. In Nigeria mathematics is learnt in English language. Mathematics teachers at junior secondary school level used English language in teaching and learning the algebraic word problems.

3.2.2 Intervening Variables

Intervening variables in this study were teachers approach to algebraic word problem lesson, teachers’ proficiency of the subject matter, students’ entry behavior in algebraic word problem lesson, students’ gender and age.
3.2.3 The Dependent Variable

The dependent variable in the study was the improved students’ performance in Mathematics. The students’ ability to use the mathematical modeling approach was indicated in their performance.

3.3 Location of the Study

The study was conducted in Bauchi State-Nigeria where the schools are based. Geographically, Bauchi State is one of the thirty six states in Nigeria and is in the North Eastern part of Nigeria. It has a population of 7.5million people (NPC, 2006). Its size is 25,573 km2. The State is divided into three geo-political zones and three educational zones. The three educational zones include: Katagum educational zone, Bauchi central educational zone and Bauchi south educational zone.

The general performance of secondary students in Mathematics and English language at both national and international examinations in Nigeria over the years continues to decline (Musa & Dauda, 2014). This challenge does not only remain with students. Mathematics teachers’ failure to convey relevant message (subject matter) to their students remain a serious challenge to the education sector. Evidence of this was observed when teachers were provided with solution to the test items from the beginning algebra. Teachers were required to provide correct answer to a wrong one, or confirm a correct answer, and identify the mistakes that they believed might have led to the students’ incorrect solutions (Ladele, 2013). It was very surprising that some of the teachers arrived at wrong answers. Some
teachers themselves appeared to initially struggle with the meaning of some questions and they also appeared to be unaware of misconceptions about variables and expressions.

Another evidence of the students’ poor performance was in the 2014 West African Senior School Certificate Examination where only 31.28% of the students had five credits and above including mathematics and English (Sa’ad, Adamu & Sadiq 2014). Furthermore, the summary of the record of statistics of this result (May/June WASSCE 2014) show that eight out of the thirty-six (36) states in Nigeria, eight (8) states recorded performance score less than 10%. These states include Adamawa, Jigawa, Sokoto, Zamfara and Kebbi, Gombe, Bauchi and Yobe states. The ten percent (10%) poor performance level indicated the percentage of students who score credit and above in mathematics and English language in the mentioned states. The ten percent (10%) poor performance level revealed that Bauchi state becomes second to the last in the list, making 98% (2%) rate of failure in mathematics and English language (WASSCE, 2014, Sa’ad, Adamu & Sadiq, 2014).

Another reason that guided the choice of schools in this zone was that, the location is primarily guided by the relatively level of good security that they have maintained for quite a long time. The study was therefore carried out in Southern Educational zone of Bauchi State, Nigeria. In addition, this zone is the concentration of more public secondary schools, compared to the number of
public secondary schools in other educational zones of the state. Mathematics teachers and students in this zone are easily accessible.

3.4 Target Population

A target population refers as the total number of responses from which the sample is drown (Kombo & Tromp, 2006). The target populations for this study were in three categories of population: target population of schools for the study, the junior secondary school students (JSS2) in the targeted schools and the mathematics teachers in the targeted schools. The total number of the targeted schools was 50. The targeted population for total enrolment of the students was 2260 (MoE, 2012). The choice of these students was due to the fact that they have learnt about the beginning algebra (Ladele, 2013) and by the fact that at this level they have a certain proficiency level of English language in their daily interactions. The JSS II level was also chosen for the study because that is when Nigerian students are formally introduced to algebra and learn the basic concepts of variables, expressions and equations. In each junior secondary school, two or three mathematic teachers teach the three levels of students. Classes are not often streamed by ability levels or students’ performance. The National policy on education, states that pupils and students at nine year basic levels of education (primary and junior) should move to the next class based on attendance and punctuality, education is free for all (NPE, 2013). The target population for mathematics teachers was 82 as at the time of this study.
3.5 Sampling Techniques and Sample Size

This section presented the sampling technique and the sample size employed in the study. A sample is a collection of some (or subset) of elements of population. The sample elements represent the population (Amin, 2005). Gibson and Brown (2009) argued that, in a study, the generalization about any study is always a matter of concern, where the issue of result from the study can play the role of sample and is used to represent a larger population considered in the study.

3.5.1 Sampling Techniques

Proportional and stratified sampling techniques were applied so that each group receives its allocation based on the original target population. This technique is useful because it helps to divide the population into relevant strata such as age, gender or geographical regions (Kombo & Tromp, 2006;). A purposeful sampling procedure was further used to get a variety of schools to participate in the study. A purposeful sampling procedure is one of the examples of non-probability sampling procedures (Kombo & Tromp, 2006; Babbie, 2010). This sampling technique would enable the researcher to get varieties of samples that have enough information that suit the purpose of the study (Babbie, 2010). Purposeful sampling procedures have to be used to take care of the characteristics among sample of students in Southern zone of Bauchi State- Nigeria. These characteristics include: gender, location, accommodation, and status.
3.5.2 Sample Size

Fraenkel and Wallen (2000) recommend at least 30 subjects per group in a research that involve quasi-experimental with particular emphasis on Solomon Four Group Design. Hence this number was adequate for the study. Kothari (2004) underline the possibility of cost consideration affecting both size and the type of the sample, thus leading to non-probability sampling being used provided the study being experimental.

From the study zone, four boarding schools included two boys and two girls’ were used respectively. Each two schools (boys and girls) were used either for control or experimental groups. In each school, only Junior Secondary School two (JSS2) classes were considered using the number the total number of boys and girls found in their respective registered list. The total number found was used to form the sample size for the study. The samplesize for teachers includes all teachers teaching mathematics in the four study schools and the exact number of mathematics teachers found in the four boarding schools was ten (10). Even though the studies focus on the junior level of education, two boarding schools each for males and females were considered. The nature of the study being experimental has necessitated the choice of the zone the four boarding schools in the state.
### Table 3.2 Sampling Grid for Boarding Schools

<table>
<thead>
<tr>
<th>Schools</th>
<th>Total</th>
<th>Sample Size</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Experimental Group (E)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Boys School</td>
<td>108</td>
<td>108</td>
<td>100%</td>
</tr>
<tr>
<td>Girls School</td>
<td>102</td>
<td>102</td>
<td>100%</td>
</tr>
<tr>
<td>Teachers</td>
<td>5</td>
<td>5</td>
<td>100%</td>
</tr>
<tr>
<td><strong>Control Group (C)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Boys School</td>
<td>108</td>
<td>108</td>
<td>100%</td>
</tr>
<tr>
<td>Girls School</td>
<td>102</td>
<td>102</td>
<td>100%</td>
</tr>
<tr>
<td>Teachers</td>
<td>5</td>
<td>5</td>
<td>100%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>430</strong></td>
<td><strong>430</strong></td>
<td><strong>100%</strong></td>
</tr>
</tbody>
</table>

Table 3.2 contains a sample of population in the four schools selected. The study used the exact number of students and teachers found in the selected four schools. This number represented the total sample for the entire targeted population. This kind of sample size is allowed for an experimental design with emphasis on Solomon Four Group Design which specifies the number of entries for each group (E1, C1, E2 and C2). Table 3.3 present the number of entries.

### Table 3.3 Showing number of students and teachers in each group.

<table>
<thead>
<tr>
<th>Group</th>
<th>E1</th>
<th>E2</th>
<th>C1</th>
<th>C2</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boys</td>
<td>55</td>
<td>55</td>
<td>55</td>
<td>55</td>
<td>220</td>
</tr>
<tr>
<td>Girls</td>
<td>50</td>
<td>50</td>
<td>50</td>
<td>50</td>
<td>200</td>
</tr>
<tr>
<td>Teachers</td>
<td>322310</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| No. (N) | 108 | 107 | 108430 |

Source: Field Survey (2015)
Table 3.3 shows experimental groups E1 and E2, number of students with more males than females C1 and C2, number of students from control groups with more males than females. The exact numbers found in each group from each school were considered as the sample size.

3.6 Research Instruments

The study employed both quantitative and qualitative ways of data collection. According to Creswell (2011) using two approaches in data gathering probe more deeply into significant issues inherent in the variables under investigation and contribute a better understanding and the interpretation of the research findings. This study therefore gathered data through the use of questionnaires, performance test, video recording and interview even classroom observation. These was to ensure that the researcher get all the available information from the respondents.

3.6.1 Questionnaires

Questionnaires were used in order to generate adequate amount of quantitative data, because it was impossible for the researcher to have all the time at his disposal. Schools have an academic calendar that guides them and the researcher had to carry out the study at the limit of time set. Moreover, structured questionnaires were used in this study because researchers have argued that they are quicker to code and analyse than word-based data within a short time frame (Cohen, Manon, & Morrison, 2007). Questionnaires have also been reported to be ideal for statistical descriptions and yield more comparable data than only qualitative data gathering method and are useful to ensure participants’
confidentiality. Against this background, a set of teacher Questionnaires on mathematics lesson particularly on word problems were used in this study for quantitative data collection.

3.6.1.1 Mathematics teacher questionnaire

A questionnaire provides self-reported information about the opinion of the respondent on various issues (Johnson & Christensen, 2012). It was developed on the first two objectives of the study. It consists of three sections (Appendix II). The first section seeks information on features like teachers’ teaching qualifications, their mathematics and JS II teaching experience. The second section included teachers responses about their proficiency level of English as a medium of instruction and their level of preparedness in the mathematics classroom. In this section, teachers were required to show or rated their responses in their used of English as medium of instruction as to a very large extend (A), to a large extend (B), not sure (C), to small extent (D) and not at all (E).

With regard to teacher’s preparedness in wordproblem lesson and the knowledge of JSS2 mathematics content. The same rating responses were used. Teachers were required to indicate how prepared they were as to a very large extend (A), to a large extend (B), not sure (C), to small extent (C) and no at all (E). These subscales were mainly adapted from Hackling and Prain’s (2005) and Olaleye’s (2012) professional learning intervention studies with Australian and Nigerian inservice science teachers respectively, and Beswick’s (2005) and Swan’s (2006)
mathematic teachers’ beliefs survey. The questionnaire (Appendix II) was completed only by the 10 teachers in the participating schools.

3.6.2 Mathematics Word Problem Solving Test (MWPST)

Before the intervention stage, students were given a pre-test. The pre-test comprising 10 short items on algebraic word problems (Appendix IV). Students who participated in the test were from experimental groups (E1) and control groups (C1). These were done in accordance to the design procedures employed in the study. The test was a mix of questions represented in word and symbols. The pre-test and post-test have considered change, compare and group aspect of algebra word problems on one and two-steps with a total of 10 tasks (or questions). Five tasks consider word problems with values or numerical and the other five word problems task with only symbols or variables. Most of the questions were adapted from existing literature or source from the most common Nigerian mathematics textbook series, New General Mathematics (NGM). Questions with given multiple answers were not used in order that that the problem-solving process (mathematical modeling) could be understood through the students’ workings.

Word problems are most suited for evaluating students’ conceptual understanding and language issues (Ni Riordain & O'Donoghue, 2009). Their difficulties were investigated through these worked solutions and performance in the questions which sought the students’ understanding of the mathematical language. The average time taken by the students to complete the test was 45 minutes. The pre-
and post-test (Appendices IV & V) were identical tests but for the arrangement of
the questions, alphabets and items were slightly different. The exact questions
were not used for the post-test in order to reduce students’ familiarity with the
questions (Chinen, 2008). Names and currency reflected those relevant to the
Nigerian society. The test was developed to measure students’ pre-test and post-
test performance in mathematics specifically in word problems.

The Newsman performance strategies were used as guide for scoring students in
the pre-test and post-test, these agrees with Polya problem solving approach. The
use of Newman procedure has been found by secondary school teachers to be “an
easily adapted and relatively simple model” in leading students as they try to
work through problems (Clarkson, 1991b, p. 245). It “has been popular with
teachers’” (White, 2005, p. 19) and is the most preferred method for interpreting
worded questions (White & Anderson, 2012). In this approach, each question
was scored 5 marks making a total of 50 marks for the 10 items. Students who use
correct equation or correct algebra to get the correct answer were scored 5 marks
in each question.

3.6.3 Classroom observation schedule

The Researcher used an observation schedule (Appendix III) to record happenings
296) noted that “at the heart of many case studies lies observation”. Observations
are a record in data gathering of happenings within a particular context (Anderson
& Arsenault, 1998; Simons, 2009). The schedule indicated specific activities of
teachers and students during the lesson that were of relevance to the study. The fourteen (14) specific activities included related to traditional approaches such as teacher explaining, students listening and copying notes; mathematical modeling related to the five Newman steps, the use of mathematical language and the correction of algebraic misconceptions. Field notes were also taken and a digital recorder was used to record the observed lessons.

The record of teachers activities were aimed at ensuring teachers used of the new technique acquired during the intervention or treatment. The motives behind the use of this approach in the mathematics classroom and particularly on algebraic word problem lesson were to ensure and enhance students’ proficiency of both the text language and the medium of instruction. Another reason for the mathematical modelling approach was to develop and improve teachers approach to the teaching and learning of word problem-solving in multilingual classrooms.

3.6.4 Newsman Interview Protocol

Punch (2005, p. 168) described interviews as “one of the post powerful ways of understanding people”. In this study, student structured interviews were used. The study has adopted the Newman interview protocol (Appendix VI), this has already been used and employed in many studies and consists of five structured questions in which students were asked in relation to a given problem that they have previously solved. This was to ensure whether they get the correct answer or not. The interview was conducted during the classroom observation lesson and
even after the post-test. The interview protocol was employed so that teachers can perceive student’s thinking and responses. The teachers and researcher used four students in each of the schools to examine how they arrived at their solutions and even the difficulties encountered in solving algebraic word problems. In each school a mathematics teacher selected four students one from each participating class. The justification for this selection was to see that each school participated in the interview. The total number of students who participated in the interview was 16. Following the pre-test and posttest, Patience, Stephen, Umar and Gloria chose 16 students (given codes S1, S2, S3, S16) to be interviewed by the researcher; to the researcher’s knowledge there were no specific criteria used for selection. It is likely that more able students would have been selected rather than a random sample. This set of students completed the pre-test and posttest from their study schools, their scripts were marked before the teachers and the researcher interviewed them using the Newman error analysis interview protocol. The findings obtained here served as supportive evidence on their performance on algebraic word problems test.

3.6.5 Focus Group Discussions

A focus group is described by Punch (2005, p. 171) as a “grouped interview” and a means of gaining insights and varied perspectives from others as the participants respond to each other’s comments on issues. A 90 minute focus group discussion was used to engage the 10 teachers who were involved in the professional learning on algebra word problem. Two group interviews were done with five
teachers in each group and the same set of three questions (Appendix VII) was used in both groups. The purpose of this was to receive information on teachers experiences after the post-tests had been carried out in the schools.

3.6.6 Digital recording and camera

A digital recorder was used to record verbal communication in the classroom, interview sessions and meetings with the teacher participants. Visuals using a digital camera captured writings of some students’ mathematical work and blackboard mathematics content. Teachers and Students’ faces were generally visible, only in some cases which were as a result of change in weather where such visibilities were not always possible.

3.7 Pilot Testing

The essence of pilot testing is to measure the strength of the instrument in terms of content and construct. A pilot study can be used as a small scale version in preparation for a major study (Polit, Beck & Hungler, 2001: 467). Baker (1994) found that a sample of 10-20 per cent of the sample size for the actual study is a reasonable number of participants to consider enrolling in a pilot.

A pilot study was first conducted to ascertain that the instruments were effective and captured the necessary information (Anderson & Arsenault, 1998). The Researcher’s supervisors as experts in the field critically appraised draft instruments to ensure the validity of the instruments. A few JSS 2 mathematicsteachers and students not belonging to the educational zones used in
the main study were given the mathematics questionnaire and algebra word problem pre-test to complete. They were asked to bring to the attention of the researcher items or questions that they were not clear about and any particular one that needed revision. As a result, there were slight changes of some words in the questionnaire and five questions were removed from the algebra test. This reduced the algebra word problem solving test questions to 10 items. The lesson observation checklist was also trialed tested in two classes to ensure that it was satisfactory. The removal of inappropriate items and ambiguous wording has enhanced the validity of the instruments.

3.7.1 Validity
The study employed both construct and content validity as it involve causal relationship that require the transformation of concept, idea or behavior into a functioning and operating reality (Trochim, 2006). Both construct and content validity are means of ensuring that indicators (items or test instruments) tap the meaning of a concept as defined by the researcher (Ellen, 2011). Some of the items used in the study were adapted from Ladele (2013), JSS2 promotion examination questions (2012, 2013 & 2014) academic years and JSS2 NGM. These strengthened both construct and content validity. This stage was followed by the pilot study whose main purposes were to check the appropriateness of the language used in the tools and to conceptualize them for predictability and reliability. The pre-test MWPST, Post-test MWPST and the MTQ were developed with the assistance of an expert form Mathematics Education Communication and
3.7.2 Reliability

Reliability is the consistency of measurement on instruments over time or stability of measurement instrument over a variety of conditions, and therefore requires the measure of association, the correlation coefficient, often termed reliability coefficient (Ellen, 2011). Since the Students’ Mathematics Achievement Test (MWPST) items had dichotomous scores with varied levels of difficulty. Their reliability coefficient was determined using Kuder-Richardson (KR-Formula 20) estimates. KR-Formula 20, as an estimate of reliability was appropriate because it required less time than any other method of estimating reliability since it was administered once and it provided the mean of all possible split half coefficients (Gay, 1992:167, Wiersma &Jurs, 2005). The KR-formula 20 used was adapted from Sattler (1988:27)

A reliability coefficient of 0.8 for pre-test MWPST was obtained. This was accepted as it was above the recommended 0.8 (Mugenda &Mugenda, 2003). MTQ was determined using the Cronbach coefficient formula adapted from Sattler (1988, p. 27). The MTQ had a reliability of 0.72 and was also accepted. In order to ensure the appropriateness of the MTQ questionnaire, pre-testing was done in one Educational Zone of Bauchi State, Nigeria. One Mathematics teacher
was given the MTQ to complete in order to discover the major flaws. The revised instruments were then administered to the sample respondents in the main study.

3.8 Data Collection Techniques

As mentioned earlier, instruments used for data collection during this study were first tested to ensure the reliability of the instruments and the feasibility of the research. Prior to the pilot study, the teachers who were to be involved in the study were trained on how to effectively integrate the intervention in mathematics classrooms to enhance learners’ problem solving ability in word problems.

3.8.1 Training of Teachers

The use of the mathematical modeling approach (MMA) for instructional purpose is seemingly new in the Nigerian education system. Involving teachers in effective integration of the interventions in this study demanded that, teachers should be trained. Since the commissioner and the director under the Ministry of Education in Buachi state were keenly interested in the proposed study, immediate approval was given to organize the training event for ten mathematics teachers selected from four boarding schools in the zone. Out of the ten teachers five were trained by the researcher. The participating teachers in the experimental schools were introduced to and trained in the strategy (Mathematical Modeling) and teachers were required to use the strategy during teaching and learning of algebraic word problems class. Teachers were told that their participation was voluntary and that whosoever wanted to withdraw could do so at any time.
To further ascertain teachers’ voluntary participation, the Teachers’ Consent Form was given to them to fill, sign and return to the researcher. The training was conducted 5 hours daily for 7 working days between the first and the second week in August, 2015. The purpose of the training included: to provide an introduction to approach in teaching and learning algebra word problem; to prepare and motivate the teachers to integrate the Mathematical Modelling Approach (MMA) into mathematics classrooms; to provide the rational for integrating the Mathematical Modelling Approach (MMA) in mathematics classrooms and to formulate and equip teachers with the necessary skills needed in assessing learners competency in solving word problems. Five of them who were engaged with the experimental schools were selected to participate in the study.

3.8.2 Pre-treatment Stage

In order to assess students’ initial level of understanding word problems in the control group and the experimental groups prior to the intervention, Mathematics Word Problem Solving Test (MWPST) was administered as pre-tests to students in the two groups (E1 and C1). The administering of these instruments was based on the design that guide the study, this design used the Solomon Four Group design, since not all the students in the four schools participated in this pretest, only half of the control and the experimental groups experience the test between 17 August, 2015 to 21 August, 2015. Though the schools were apart, yet with the help of the research assistant all the participation groups were able to write the test at the same time and in the same date.
3.8.3 Treatment Stage

After the pre-treatment or pre-test, the treatments were administered on Junior Secondary School two (JSS2) students in the experimental groups. In administering the treatments, teachers in the experimental groups taught students (JSS2) word problem using the Mathematical Modelling Approach (MMA) for 70 minutes every working day for three weeks. In all the groups, the focus of the study was on word problems that involved combine, compare and group word problems of one or two steps as aspects of mathematics content.

In the teaching aspect of word problems, teachers were required to show how to apply modeling procedures in solving problems as this requires formulation of equations. A model is an education in this study as it involves a representation of an object or situation (Eu, 2013). The term mathematical model generally refers to the mathematical structure that is similar to a real-world problem or phenomenon. The researcher adopted a mathematical modeling approach in teaching that aspect of word problem and is also known as step by step approach (Forsten, 2010). Mathematical modeling includes stages such as problem viewing, formulation of model, solving or solution process, interpretation, validation of conclusion and reporting. Figure 3.1 shows the proposed mathematical modelling process in teaching some selected content in algebraic word problems.
Figure 3.1 indicated various stages of mathematical modeling which experimental teachers were expected to use in teaching and learning algebraic word problems content in their respective classes. The major objective here was for students to learn how to use the modeling process, by viewing or analyzing the problem situation, developed and formulate a model. Also students were required to solve or compute solution of the model after which they interpret the solution and as well draws conclusion and report (Forsten, 2010). Teaching in this group was interactive with the teacher’s use of the questioning and explanation techniques which were required in the modeling approach.

Furthermore, during each lesson, teachers were required to teach students read the entire problem and rewrite the question in a sentence form, as this promotes student comprehension or understanding of the problem and helps guide their thinking and modeling abilities. Determine who and/or what is involved in the problem. Chunk the problem, set the symbols and the numerical correctly into an equation.
form using relevant operations. Compute and solve the problem. Write the answer in the sentence, and make sure the answer makes sense. Digital cameras and tapes were used to record the conversations and then transcribed by the researcher himself. The essence of this classroom observation was to ensure teachers effectiveness in their use of the approach in teaching and learning of word problems.

3.8.4 The Control Group

In the control groups, the setting and instructional process was predominantly the traditional classroom which emphasizes teacher centered instructional process which relies on Mathematics textbook and teacher’s explanations. Teaching and learning in the control group followed the traditional pattern of the teacher-centered classroom. The teacher was mainly involved in the talking, presentation of instructional content, identification and explanation of difficult words as well as the assigning of homework at the end of the lessons. Most times, the teachers are engage on solving most of the word problems questions. Teachers can only read the problem solve it by themselves. It more of teachers centered than students. Students are busy while copying and taken note.

In most cases, teacher’s explanation of the lesson content required little or no input from the pupils. Students in the control group indicated their willingness to answer. Most times, the teacher provided solutions or explanations when pupils did not respond to answer questions. More often than not, little or no effort were made by the teacher in the traditional classroom to encourage pupils’ talk. Pupils
in this group were hardly given the opportunity to ask questions. Rather, the teacher’s questions which often attracted “Yes” and sometimes “No” as the chorus answer from the pupils was “do you understand?” As a matter of fact, from the beginning to the end of the lesson, pupils sat to face the teacher as well as the chalkboard. More often, the pupils were mere listeners to the teacher’s talk rather than being actively engaged. A few minutes towards the end of the lessons, the teacher usually wrote the summary of each lesson on the chalkboard for the pupils to write in their notebooks.

3.8.5 Post-treatment stage

The two experimental schools were exposed to the mathematical modeling approach and while the control group was taught using normal in mathematics classrooms for four weeks. There after the MWPST were administered to all the groups as post-test to assess possible changes in pupils’ level of problem solving ability in word problems. All instruments were administered as post-test in the 4th week of the study. Within two days of the post-test week, the teachers’ and students’ interviews were conducted after the schools’ closing time.

3.9 Procedure for Instruments’ Scoring and Data Coding

The Mathematics Word Problem Solving Tests which were students’ achievement test were mean to obtain responses from the students. The achievement test was scored using Newsman performance strategies. In this strategy, students were required to follow steps in their solutions to all the 10 items in the instrument. By
this strategy, each step in the five steps was awarded 1 mark for the correct answer (step). In this procedure the rating ranged between 0 and 5. Score obtained in each item of the achievement tests was also entered into the SPSS statistics data editor for each student.

The mathematics teacher questionnaires requires teachers show or rated their responses in their used of English as medium of instruction as to a very large extend (A), to a large extend (B), not sure (C), to small extend (D) and not at all (E). On teacher’s preparedness in word problem lesson and the knowledge of JSS 2 mathematics content. The same rating responses were used. Teachers were required to indicate or rated how prepared they were as to a very large extend (A), to a large extend (B), not sure (C), to a small extend (C) and not all (E).

In the scoring procedure, teachers responses on each item for both proficiency level and teachers prepared level were measured with the same numerical value were responses (A, B, C, D and E) indicated teachers frequency count on each item on mathematics teacher questioners. The data were entered into the statistic data editor of SPSS 17 software package. After all data in all the tests and questionnaires were entered for each student and teachers in the various groups, data files were combined with each group assigned identification number 1 and 2 for analysis.
3.10 Data Analysis

The statistical analysis of the data gathered for this study was performed by using descriptive and inferential statistics. The descriptive statistics employed included mean and standard deviation, percentages, frequency distribution tables. The independent t-tests, Analysis of variance (ANOVA) and Scheffé’s Comparism. The rationale for the use of the statistical tools employed in this study was based on the nature of the hypothesis tested. The analysis therefore was done in this order;

a) Analysis of objective one and Research question one: to establish teachers’ proficiency level of English as a language of medium in teaching and learning word problems (teachers subject matter knowledge, content knowledge, teachers approach/strategies, knowledge of content and student), the statistical tools or packages that were used in the analysis of the objectives include parametric test such percentages, frequency count of the responses. The research question was tested and analyzed using percentages and frequency count. This were compared how teachers responded to their proficiency levels in using English as a language of instruction in word problem class.

b) Analysis of objective two and Research question two: to establish teachers’ preparedness (readiness, confident, willingness and interest) in their use in teaching and learning of word problems (English written statements) at junior secondary school level. Teachers preparedness were analyzed using percentages and frequency count of responses. The percentages on teachers were compared to show how teachers responded to their level of preparedness in teaching and learning algebraic word problems.
c) **Analysis of objectives three and Research Hypothesis one:** to assess the effect of English language through mathematical modeling with regard to students’ performance, data obtained were students’ scores on MWPST. Statistical tools that were used include; t-test statistics to compare whether there exist a difference in the sample means between experimental and control groups, between males and females in both pretest and posttest MWPST. Analysis of Variance was also used to compare whether there was a significant difference in sample means between the four groups in the posttest. Scheffes comparison was further employed to test the statistically significance differences in the means students’ performance in posttest MWPST if it really occurred.

d) **Analysis of objective four and Research Hypothesis two:** to assess the effect of mathematical modeling on gender performance among junior secondary schools students. The t-test statistics was used to determine whether there was no significance difference of the mean performance between male and female JSS2 students. This was computed and analyzed using SPSS/PASW 17 for an accurate result. Table 3.4 gives the summary of the statistical tools.

e). **Analysis of objective five (Modified Proposed Mathematical Modelling Approach)**

This required that the researcher developed or modified a proposed mathematical modeling approach with a simple lesson plan in word problems. The trained teachers have also developed a simple lesson plan for a mathematical modeling approach in their teaching and learning algebraic word problem content. In their lesson plans, teachers included the objectives of the lesson, the children previous
knowledge and the introduction as the basis in a lesson plan. Also teachers and students activities were included in all the steps in the modeling procedures. In the modeling procedures teachers guided the students in each stages until they obtained a good solution to the problem identified. Table 3.4 present a summary of statistical tools.

**Table 3.4: Summary of statistical tool**

<table>
<thead>
<tr>
<th>Hypothesis/ Objectives</th>
<th>Statistical Procedures</th>
<th>Looking For</th>
</tr>
</thead>
<tbody>
<tr>
<td>RQ1, (Objectives 1)</td>
<td>Frequency count and percentages.</td>
<td>Percentage levels of teachers proficiency of English language in word problems</td>
</tr>
<tr>
<td>RQ2 (Objectives 2)</td>
<td>Frequency count and percentage</td>
<td>Percentage levels of teachers preparedness in word problem</td>
</tr>
<tr>
<td>H₀1, (Objective 3)</td>
<td>t-test statistics and ANOVA</td>
<td>Significant level on the effect of English on students’ performance</td>
</tr>
<tr>
<td>H₀2, (Objectives 4)</td>
<td>t-test statistics and ANOVA</td>
<td>Effect of mathematical modeling on gender performance</td>
</tr>
</tbody>
</table>

Table 3.4 indicates the various statistical tools employed in the analysis of the research hypothesis based on the objectives that guide the study.

### 3.11 Logical and Ethical Considerations

The research was carried out in line with ethics approval received from Graduate School of Kenyatta University in July 2015. Permission for access to the teachers and students was obtained from the Bauchi State Ministry of Education. The introductory letters were addressed to the principals of the four study schools. This has provided access to meet with teachers and students in the study schools.
Letters of consent were signed by teachers to indicate their interest to take part in the research. These teachers were willing and have participated in the professional teaching and learning. All participants were informed that they could withdraw their participation in the research at any time. The Researcher made sure the students felt at ease throughout the classroom observations and interviews, and they were at no time compelled to respond. All participants were assigned numerical codes which were used for data analysis.

3.12 Chapter Summary

This chapter described the research design, locale, sample and sample techniques, development of research instruments, procedures for administration of the instruments. It also described the reliability and validity of the research instruments, method of data collection as well as the method of data analysis and the ethical consideration for the study. The next chapter describes the methods of data analysis, presentation, interpretation and discussion of research findings.
CHAPTER FOUR
PRESENTATION OF FINDINGS, INTERPRETATION AND DISCUSSION

4.1 Introduction

This study focused on the effect of English language on students’ performance in teaching and learning Mathematical Modelling at junior secondary school level in Bauch State, Nigeria. The first objective was to establish teachers’ proficiency level of English language as a second language in teaching and learning of junior secondary school two (JSS2) students in algebraic word problems. The second objective was to determine teachers’ prepared level in their teaching and learning junior secondary school two algebraic word problem. The third objective was to find out the effect English language on students’ performance in word problems through mathematical modeling. The fourth objective was to find out the effects of mathematical modeling on gender performance among junior secondary school two (JSS2) students. The last objective was to formulate mathematical modelling that would improve junior secondary school students’ performance in algebraic word problems.

In order to achieve the above objectives, the study was guided by two research questions and two research hypotheses. The first research question was that, what was the teachers’ proficiency level of English as a language of instruction in teaching and learning of mathematical modeling at junior secondary school level?
The second research question was that, what was the level of teachers’ preparedness in their in teaching word problems at junior secondary school level?

The first hypothesis was that, there was no significant difference in the effect of English Language on junior secondary school students’ performance on word problem. The second hypothesis was that there was no significant difference on the effects of mathematical modeling on gender’ performance in word problems.

### 4.2 Demographic Information

Both junior secondary two students and their teachers have participated in the study. Most of the students were between 11 and 13 years of age and this is the required age for entry into junior secondary level of education (NPE, 2004). Four boarding schools were used for the study.

The choice or selection of these schools was necessary due to the fact that they are owned and controlled by the Bauchi State government. The Bauchi State Ministry of Education is fully in charge of the affairs of all boarding schools established by the state government. The enrollment or admission of students is central and students from all over the state and beyond are always considered for admission into the schools, unlike Day secondary schools which are under the supervision of Local Education Authority (LEA), were the admission of students are based on the community consideration. In the Boarding secondary schools only the junior secondary school level two (JSS2) were considered in the study.

Table 4.2.1 present the number of students based on gender.
Table 4.2.1: Showing sample of JSS 2 Students in the study

<table>
<thead>
<tr>
<th></th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex</td>
<td>Male</td>
</tr>
<tr>
<td></td>
<td>Female</td>
</tr>
<tr>
<td></td>
<td>Total</td>
</tr>
</tbody>
</table>

**Source:** Field Survey, 2015.

Table 4.2.1 shows number of students based on gender. The number of males students (M= 216) were higher than females students (F=204). The variation exists because it was the exact number of students found from the study schools (table 3.1). The study also considered ten (10) mathematics teachers from the four boarding schools used in the study. The study area was Bauchi Southern educational zone. The four schools located in zone are categories into sub-educational zones. Teachers were classified into these zones. Table 4.2.2 presents these data.

Table 4.2.2 Teachers by Sex, Zone and Age Group (n= 10)

<table>
<thead>
<tr>
<th></th>
<th>Number</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex</td>
<td>Male</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>4</td>
</tr>
<tr>
<td>School zone</td>
<td>Bauchi Central</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>K. Madaki/Dass</td>
<td>5</td>
</tr>
<tr>
<td>Age group (years)</td>
<td>21 to 25</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>26 to 30</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>31 to 35</td>
<td>1</td>
</tr>
</tbody>
</table>

Table 4.2.2 shows that teachers were between 21 and 25 years of age (40%). This is a clear indication that these teachers were found to be at their active years of
service and have fully participated in the study. Most of the teachers (70%) were between 26 and 30 years of age and the number of male respondents (60%) was more than the females (40%). In relation to mathematics teaching, almost all (70%) of the teachers had between three and five years of experience. Table 4.2.3 present these data.

**Table 4.2.3 Teachers of Mathematics and JS 2 Experience**

<table>
<thead>
<tr>
<th>Years of experience</th>
<th>Mathematics Teaching</th>
<th>JS2 teaching</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-2</td>
<td>2(20.0)</td>
<td>0(0.0)</td>
</tr>
<tr>
<td>3-5</td>
<td>7(70.0)</td>
<td>8(80.0)</td>
</tr>
<tr>
<td>6-8</td>
<td>1(30.0)</td>
<td>2(20.0)</td>
</tr>
</tbody>
</table>

**Source:** Field survey 2015

Table 4.2.3 shows that more than half (80%) of the teachers had between three and five years’ experience of teaching JSS 2 mathematics. It is an indication that, the availability of experienced teachers in the secondary schools mathematics could bring about better students’ academic performance in the subject. All the teachers had undergone a three or four year training to obtain a professional mathematics teaching qualification. These data are presented in Table 4.2.4

**Table 4.2.4: Showing Level of Teachers Qualifications (n =10)**

<table>
<thead>
<tr>
<th>Qualification</th>
<th>Number</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>NCE only</td>
<td>5</td>
<td>50.00</td>
</tr>
<tr>
<td>B.Sc(Ed) only</td>
<td>2</td>
<td>20.00</td>
</tr>
<tr>
<td>B.Sc/PGDE</td>
<td>3</td>
<td>30.00</td>
</tr>
</tbody>
</table>

Table 4.2.4 indicated that all the mathematics teachers had educational teaching qualification. It was an indication that all teachers were qualified to teach
mathematics in the junior secondary school level of education in Nigeria. Some of the teachers also had a second specialization and the most common of these were economics, integrated science and physics. Half of the teachers (50%) reported to have the primary and junior secondary minimum teaching qualification (NCE) which they had attended. The remaining half of teachers had first degree in mathematics education and applied mathematics respectively.

4.3 Results

4.3.1 Teachers Proficiency of English language in the Mathematics Classroom

The first objective of the study was to establish teachers’ proficiency level of English language as a medium of instruction in mathematics classroom, specifically on teaching and learning of algebraic word problems. Responses on teachers’ proficiency level of English were investigated on how teachers conveniently use English as a language of instruction in word problems class. Teachers’ proficiency level of English in algebraic word problems were observed in areas such as; reading process, elaboration of a problem, relating symbols with words and making sense model. The ten (10) teachers who participated in the study were also required to rate to the extent to which they conveniently used English as a language in the areas mentioned. The responses were follows as: to a very large extent = A, to a large extent = B, not sure = C, to a small extent = D and not all = E, respectively. The results are presented in Table 4.3.1.
Table 4.3.1 Percentage of Teachers’ Responses on Proficiency of English in Algebraic Word Problem (n = 10).

<table>
<thead>
<tr>
<th></th>
<th>Statement</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>My knowledge of English help me in establishing a classroom atmosphere for students to answer question</td>
<td>A: 2  B: 1  C: 3  D: 1  E: 1  40%  20%  10%  20%  10%</td>
</tr>
<tr>
<td>2</td>
<td>My knowledge of English in word Problem class enable students read allowed during lesson</td>
<td>A: 2  B: 0  C: 1  D: 2  E: 2  50%  20%  0%  10%  20%</td>
</tr>
<tr>
<td>3</td>
<td>My knowledge of English in word Problem class enables me respond appropriately to students question</td>
<td>A: 4  B: 2  C: 0  D: 23  E: 23  40%  20%  0%  20%  30%</td>
</tr>
<tr>
<td>4</td>
<td>My knowledge of English enables me ask students identify key words figures and symbols in the question</td>
<td>A: 3  B: 0  C: 2  D: 3  E: 3  30%  3%  0%  20%  30%</td>
</tr>
<tr>
<td>5</td>
<td>I felt conveniently when asking and discussion in word problem class</td>
<td>A: 2  B: 1  C: 5  D: 0  E: 2  20%  10%  50%  0%  20%</td>
</tr>
<tr>
<td>6</td>
<td>I sustained students interest in in algebra word problem class</td>
<td>A: 0  B: 1  C: 4  D: 2  E: 3  0%  10%  40%  20%  3%</td>
</tr>
</tbody>
</table>

Table 4.3.1 shows that forty percent (40%) of the teachers shows to a very large extend in which their level of proficiency of English help them in making students developed more confident in word problems. This shows the impact of the intervention on teachers as only ten percent (10%) of teachers could not establish a good atmosphere during algebra word problem class. Findings also revealed that half of teachers encourage reading as a step of learning word problem by students.
Reading habit in algebraic word problem lesson is step in problem solving. In support of this finding, Forsten, (2010) further maintained that to be successful in word problems, students’ ability to read word problems always count into his or her success in algebra lesson. Regard to teacher respond to students question in word problem question, result indicated that forty percent (40%) of teachers were found to use their knowledge of English to a very large extend to response appropriately or provide answers to students questions. Teachers’ ability to respond appropriately to students question has demonstrated their ability to comprehend those processes in mathematical modelling approach as it entails deeper and understanding of word problems.

Furthermore, table 4.3.1 also indicated teachers with similar level of proficiency of English in helping students identify key words, figures and symbols in word problem class. This was observed as thirty percent (30%) of teachers shows to a very large extent to which they use their proficiency of English in teaching word problems, thirty percent (30%) of teachers in the same group who could not use their proficiency level of English in to help students identify keys words. Result has indicated that at least fifty percent (50%) of the teachers were not sure whether their proficiency level of English make them felt conveniently when asking students question during teaching and learning algebra word problem.

Table 4.3.1 also revealed that non (0%) of the teachers uses home or native language sustain students interest in word problem class and forty percent (40%) have shown that, they are not sure where native language can sustain students
interest in word problem. In conclusion, the responses of teachers from this findings revealed that increased in teachers proficiency of English count their success in teaching algebra word problem, if really students are to excel. This finding concord with Fakaye (2009) who suggests that as teachers’ English proficiency increases, so is also academic success. Hence the need for teachers to use mathematical modeling approach in algebra word lesson.

4.3.2 Teachers Preparedness in Teaching Word Problems.

The second objective in the study was to determine teacher’s preparedness in teaching and learning JSS2 algebraic word problems. Teachers’ responses on preparedness in word problem class were observed in terms of concept introduction, discussion, interpretation of terms, development equation in word problems and using the equation to solve related word problems. The ten (10) teachers who participated in the study were also required to rate to the extent to which they are prepared in teaching algebraic word problem, responses were rated as preparedness to a very large extend = A, prepared to large extend = B, not sure = C, prepared to small extend = D, prepared not all = E. Responses were computed in terms frequency count and percentages. Table 4.3.2 present the data.
Table 4.3.2 Percentage of Teachers’ Responses on Preparedness in Algebraic Word Problem (n =10).

<table>
<thead>
<tr>
<th>Statement</th>
<th>Responses</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Explaining algebra concepts in word problem using simple expression</td>
<td></td>
<td>4</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>40%</td>
<td>10%</td>
<td>10%</td>
<td>0%</td>
<td>30%</td>
</tr>
<tr>
<td>2 Developing vocabulary and terms needed for solving algebra word problems</td>
<td></td>
<td>5</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>50%</td>
<td>10%</td>
<td>0%</td>
<td>10%</td>
<td>30%</td>
</tr>
<tr>
<td>3 Managing group activities in word problem</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20% 20% 20% 20% 20%</td>
<td></td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>4 Engaging students in solution to algebraic word problems</td>
<td></td>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>2</td>
<td>0</td>
<td>2</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>40%</td>
<td>20%</td>
<td>0%</td>
<td>20%</td>
<td>20%</td>
</tr>
<tr>
<td>5 Managing discussion and interpretation of word problems</td>
<td></td>
<td>1</td>
<td>2</td>
<td>0</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>50%</td>
<td>10%</td>
<td>20%</td>
<td>0%</td>
<td>20%</td>
</tr>
<tr>
<td>6 Assessing children learning algebra word problems through their misconception</td>
<td></td>
<td>5</td>
<td>2</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Algebra word problem</td>
<td></td>
<td>50%</td>
<td>20%</td>
<td>0%</td>
<td>10%</td>
<td>20%</td>
</tr>
</tbody>
</table>

Table 4.3.2 shows that forty percent (40%) of teachers responded that they prepared to a very large extend in explaining word problem using simple algebraic expression while thirty percent (30%) reported that they don’t make any preparation in explaining algebra concept. This finding is an evident that, there was an improvement in teachers’ preparedness in explaining word problems concept. The result also revealed that fifty percent (50%) prepared to a very large extend in developing vocabulary and terms needed to solve word problems, whereas thirty percent (30%) could not prepared at all. This findings show that
teachers have improved in their preparedness as they used the knowledge in mathematical modeling in their teaching of word problems. With regard to managing group discussion in word problems, teachers show similar responses (20%) in their levels of preparedness in word problem class.

Further findings revealed that half or fifty percent (50%) of teachers prepared to a very large extend in managing discussion and interpretation in algebra word problem class whereas only twenty percent (20%) of teachers shows that they don’t prepared at all in managing discussion and interpretation in word problem class. Also in assessing students in word problems as part of the strategy in mathematical modelling procedures, result indicated also fifty percent (50%) of teachers prepared to a very large extend in assessing students procedures in word problems whereas only twenty percent (20%) could not prepared at all. In support of this findings, Sepeng (2010) shows that teachers readiness and preparedness in word problem class through the introduction of discussion and argumentation techniques in the teaching and learning of mathematics word problems increases problem-solving and sense making abilities of English second language learners.

In conclusion, the classroom practices aimed at enhancing students’ performance in mathematics. Mathematical modeling which is a strategy aim at improving second language learners performance would be of a great significance in word problem if the practice involve the use of the approach by mathematics teachers at junior secondary school in Nigeria and beyond.
4.3.3 Effects of English Language on Students’ Performance in Algebraic Word Problems.

Findings on effects of English language in teaching and learning word problems were observed and scored on the five stages of mathematical modeling adopted from Newsman (1983b & Fostern, 2010) performance strategies. The study employed the Solomon four-group design. These have enabled the researcher to have two groups set for pre-tests as recommended by Borg and Gall (2003). The two groups were Experimental group (E1) and Control group (C1). A pre-test MWPST was therefore administered to JSS2 in groups E1 and C1 prior to the experiment. The pre-test contained 10 items that sought to test students understanding of the word problems, which was the focus of this study. The mean scores for the two groups (E1 and C1) were computed using the SPSS Program. Table 4.3.4 present the result.

Table 4.3.3 Students’ Performance in the Pre-test MWPST by Groups.

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>M</th>
<th>S. D.</th>
<th>S.E of Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>E1</td>
<td>105</td>
<td>9.68</td>
<td>8.263</td>
<td>.55210</td>
</tr>
<tr>
<td>C1</td>
<td>100</td>
<td>8.85</td>
<td>7.234</td>
<td>.52404</td>
</tr>
</tbody>
</table>

Table 4.3.3 shows that students from experimental group E1 performed better (M = 9.68, S.D = 8.26) than students from control groups C1 (M = 8.85, S.D = 7.234) in the pre-test mathematics word problems. In order to test whether there was a significant difference on effect of English language on students performance between experimental group E1 and control group C1 in the pre-test, MWPST, a t-test was computed using SPSS Program. Table 4.3.4 present the result.
Table 4.3.4 Independent Samples t-test Pre-test Mean Scores on MWPST

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>Mean</th>
<th>Std. Dev.</th>
<th>T-value</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>E1</td>
<td>105</td>
<td>9.68</td>
<td>8.26</td>
<td>203</td>
<td>0.919</td>
</tr>
<tr>
<td>C1</td>
<td>100</td>
<td>8.85</td>
<td>7.23</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 4.3.4 of the independent t-test reveal a statistically insignificant difference in the mean scores of pre-test MWPST for the experimental (E1) and control groups (C) at t (203) = 0.919, p = .326, α = .05 where p > 0.05. This is a clear indication that students’ performance in the pretest was similar and their level of understanding word problem was also the same. Thus, the hypothesis which stated that, there was no significant difference on the effects of English language on students’ performance was retained. This findings agrees with Njoroge & Githua (2013) which in their study found that there was no statistically significant between experimental and control group difference in the pretest Mathematics Achievement Test (MAT) prior to the commencement of the intervention on Cooperative learning Strategy (CLS).

The study was also interested in determining the performance of students based on gender prior to the commencement of the treatment using only experimental groups E1. Pre-testing only experimental group E1 without Control groups C1 based on gender is allowed in the Solomon four group design as it would provide a basis for gender performance comparison in the post-test. Table 4.3.6 present the result.
Table 4.3.5: Students Performance in the Pre-test MWPST by Gender

<table>
<thead>
<tr>
<th>Gender</th>
<th>N</th>
<th>Mean</th>
<th>SD</th>
<th>S.E of Mea</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>55</td>
<td>3.60</td>
<td>.45</td>
<td>.2345</td>
</tr>
<tr>
<td>Female</td>
<td>50</td>
<td>3.40</td>
<td>.45</td>
<td>.2330</td>
</tr>
</tbody>
</table>

Table 4.3.5 shows that the males students performed better ($M = 3.60$, $S.D = .45$) than the females students ($M = 3.40$, $S.D = .45$) in the pre-test MWSPT. In order to test whether there was a significant difference between the students’ gender and performance in pre-test MWPST, a t-test was computed using SPSS Program. The results are presented in Table 4.3.6

Table 4.3.6: Independent Samples t-test Pre-test Mean Scores on MWPST base on Gender

<table>
<thead>
<tr>
<th>Gender</th>
<th>N</th>
<th>Mean</th>
<th>SD</th>
<th>DF</th>
<th>T-value</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>55</td>
<td>3.60</td>
<td>.45</td>
<td>108</td>
<td>13.16</td>
<td>.240</td>
</tr>
<tr>
<td>Female</td>
<td>50</td>
<td>3.40</td>
<td>.45</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 4.3.6 shows that the means significant difference in the pre-test MWST performance between male and female students were statistically insignificant, at $t (108) = 13.16$, $p = .240$, $\alpha = .05$ where $p > .05$.

This implies that students’ performance in the MWPST pre-test was similar before the commencement of the intervention on the new strategy (MMA), the hypothesis which stated that there was no significance difference on gender performance in word problems was then retained. This finding agrees with Benson (2015) which on his study on Effects of Mathematical Vocabulary Instruction on Students’ Achievement in Mathematics in Secondary Schools of
Murang’a County, Kenya found no significance difference on gender performance.

To further investigate the above stated objective and hypothesis, a posttest was also administered to the same categories of students. In this investigation, the researcher also employed the Solomon four group design where all groups experienced the posttest. The post-test MWPST contained 10 items which were also scored based on Newsman (1983a) performance strategies. Table 4.3.7 gives the mean score of students’ performance in the posttest MWPST.

**Table 4.3.7 MWPST Post-test Mean Score obtained by the Students in the 4 Groups**

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>M</th>
<th>SD</th>
<th>Std Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>E1 (1)</td>
<td>105</td>
<td>2.69</td>
<td>1.17</td>
<td>.11429</td>
</tr>
<tr>
<td>C1 (2)</td>
<td>105</td>
<td>1.50</td>
<td>0.87</td>
<td>.10120</td>
</tr>
<tr>
<td>E2 (3)</td>
<td>105</td>
<td>2.19</td>
<td>1.10</td>
<td>.08631</td>
</tr>
<tr>
<td>C2 (4)</td>
<td>105</td>
<td>1.09</td>
<td>1.05</td>
<td>.10454</td>
</tr>
</tbody>
</table>

Table 4.3.7 shows that students of experimental group E1 have better performance (M= 2.69, SD = 1.17) than control group C1 (M=1.50, SD = .87) in the post-test MWPST. It also revealed that experimental group E2 have better performance (M= 2.19), SD = 1.10) in the post-test MWPS. This is a clear indication that experimental groups E1 and E2 who were exposed to mathematical modeling approach have shown a better performance than the control groups C1 and C2 respectively. The implication here is that when learning word problem through mathematical modeling, students’ performance in learning mathematics would
increase. In support of these findings, Lesh & Zawojewski, (2007) view that engaging students in mathematical modeling activities would help them arrive at mathematical ideas in problem solving, and hence performance increased.

To test hypothesis one (H$_0$1) which states that, there is no statistically significant means difference in the effect of English Language on junior secondary school students performance on word problem, analysis of variance (ANOVA), was also carried out on posttest MWPST scores. Table 4.3.8 gives the result of the ANOVA of the difference in the post test MWPST scores.

**Table 4.3.8: ANOVA Post-test Results of MWPST between the 4 Groups**

<table>
<thead>
<tr>
<th></th>
<th>Sum of squares</th>
<th>df</th>
<th>Mean score</th>
<th>F</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between groups</td>
<td>155.14</td>
<td>3</td>
<td>51.712</td>
<td>48.63</td>
<td>.000</td>
</tr>
<tr>
<td>Within groups</td>
<td>427.46</td>
<td>417</td>
<td>1.063</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>582.594</td>
<td>420</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 4.3.8 shows that there was a significant mean difference in the student performance in the posttest MWPST between the 4 groups, $F(417) = 48.63$ $p = .01$, $\alpha = .05$ where $p<0.05$. The study thus concluded that using mathematical modeling in learning algebra word problem increase students proficiency of the language of instruction and the text language. Therefore the hypothesis (H$_0$1) which states that, there was no significance difference on effect of English language on students’ performance was rejected. Since this result was statistically significant, further follow up tests were performed using Scheffe comparison and Table 4.3.9 presents the result.
Table 4.3.9: Scheffe Comparison Test of the Mean Differences between the Control and Experimental Groups

<table>
<thead>
<tr>
<th>I Group</th>
<th>J Group</th>
<th>Mean Difference (I-J) P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scheffe</td>
<td>E1</td>
<td>.49571*</td>
</tr>
<tr>
<td></td>
<td>E2</td>
<td>.19066*</td>
</tr>
<tr>
<td></td>
<td>C1</td>
<td>1.59571*</td>
</tr>
<tr>
<td></td>
<td>C2</td>
<td>.40505</td>
</tr>
<tr>
<td>E2</td>
<td>E1</td>
<td>-.49571*</td>
</tr>
<tr>
<td></td>
<td>C1</td>
<td>.69495*</td>
</tr>
<tr>
<td></td>
<td>C2</td>
<td>1.10000*</td>
</tr>
<tr>
<td>C1</td>
<td>E1</td>
<td>-1.19066*</td>
</tr>
<tr>
<td></td>
<td>E2</td>
<td>-.69495*</td>
</tr>
<tr>
<td></td>
<td>C2</td>
<td>.40505</td>
</tr>
<tr>
<td>C2</td>
<td>E1</td>
<td>-1.59571*</td>
</tr>
<tr>
<td></td>
<td>E2</td>
<td>-1.10000*</td>
</tr>
<tr>
<td></td>
<td>C1</td>
<td>-1.40505</td>
</tr>
</tbody>
</table>

Table 4.3.9 shows a Scheffe posthoc comparisons which indicated that there was significant means differences between experimental groups E1 and E2 ($\rho = .009$) and also between experimental group E1 and control group C2 ($\rho = .001$). It also revealed that there was a significance differences between experimental group E2 and E1 ($\rho = .009$) and between experimental group E2 and control group C1 ($\rho = .001$). It when further to revealed that there was a significant difference in experimental group E2 and control group C2 ($\rho = .001$) and also between control group C1 and experimental group E1 ($\rho = .001$). The means significance difference was also revealed between control group C2 and experimental group E1($\rho = .001$) and between control group C2 and experimental group.
E2(ρ=0.001) in the performance of Post-test MWPST. In addition it revealed that there was no statistically significant difference between experimental groups C1 and C2 (ρ =0.053) and between control groups C2 and C1 (ρ =0.053) in performance of post-test MWPST.

A Scheffe post hoc test thus revealed that there was a statistically significant mean difference between the experimental groups E1 and control group C2 (ρ =.001). The first hypothesis, H₀₁ that, there was no significant difference on effect of English language between students’ performance using mathematical modeling was rejected. To further test on the rejection or acceptance of the same hypothesis H₀₁, the design used in the study also allowed for general combination of the four groups into two groups to compare students performance in the post-test MWPST. This was done by categorizing the four groups into two groups of experimental (E1 and E2) and control (C1 and C2) then running the test. Table 4.3.10 presents the result.

**Table 4.3.10: Independent Sample t-test Post-test Mean Score on MWPST between Experimental and Control Groups**

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>Mean</th>
<th>S. D</th>
<th>df</th>
<th>T-value</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experimental</td>
<td>210</td>
<td>2.44</td>
<td>1.12</td>
<td>414</td>
<td>31.20</td>
<td>.000</td>
</tr>
<tr>
<td>Control</td>
<td>210</td>
<td>1.30</td>
<td>1.0</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Source:** Field Survey, 2015

Table 4.3.10 showsthat there was a significance means difference in the posttest MWPST between experimental and control groups t (414) = 13.1, p = .001, α = .05,
p<0.05. The same hypothesis, $H_0$, that there was no significant means difference between students’ performance on effects of English language through mathematical modeling approach was rejected. Thus, the study concluded that there was a statistically significance difference on effect of English between the students’ performance when taught word problems using mathematical modelling approach.

4.4 Effects of mathematical modeling on gender performance.

In order to find out the effects of mathematical modeling on gender performance in word problems, ten (10) post-test MWPST were developed and the result were only considered on experimental groups (E1 and E2). This was allowed in the design employed in the study, the reasons for considering only the experimental group on gender basis was due to the fact that it was the only group that was exposed to the new strategy. In order to test whether there was a statistically significant difference on effect of mathematical modeling between males and females performance in word problems, post-test MWPST, a t test was computed using SPSS Program. The result are presented in Table 4.4.1

<table>
<thead>
<tr>
<th>Gender</th>
<th>N</th>
<th>Mean</th>
<th>SD</th>
<th>Df</th>
<th>T-value</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>108</td>
<td>2.11</td>
<td>1.10</td>
<td>207</td>
<td>20.20</td>
<td>.000</td>
</tr>
<tr>
<td>Female</td>
<td>102</td>
<td>2.84</td>
<td>1.03</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>210</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 4.4.1 shows that there was a significance means difference in the posttest MWPST between males and females experimental groups $t(207)= 20.20$, $p= .001$, $\alpha = .05$, $p <0.05$. This implies that males and females who were taught using the Mathematical modeling approach show a significant difference in their performance. Hypothesis $H_0$, which stated that there was no statistically significant gender difference in performance in learning wordproblems using mathematical modeling teaching strategy, is thus is rejected.


The participating teachers during the training have developed their own lesson plans using the template of the MMA approach (Appendix VIII). The lesson plans for the participating teachers were best on five selected topic (Appendix IX). The selected algebraic word problems contain in the New General Mathematics JSS2 textbook (Macmillan). The five topics were taught for five weeks using the mathematical modeling procedures. The experimental teachers were already trained in the new strategy (MMA). In the study the researcher developed the mathematical modeling approach strategy based on step-by-step (Forsten, 2010 & CSSM, 2010 ). In teaching the word problems content, the followings were taking into considerations by the experimental teachers;

i. A teacher was required to introduce the concept to be learnt during lesson.

ii. A teacher then prepare a lesson on algebraic word problem topic which required the a step-by-step Modelling process
iii. In presenting the lesson teacher explained how the students were to use the modeling process to get the correct solution.

iv. The students were given time to practice the approach on the problem being in groups

v. The students were allowed to share their work with other students from another groups

vi. The students were also allowed to presented their in groups

vii. The teacher harmonized the results and made conclusions.

The lesson plans were observed by the researcher to ensure that teachers used the strategy as acquired. Areas of improvements were suggested. The teachers agreed that the lesson must include; introduction, objectives, activities and conclusion as basis aspect of lesson plans (Appendix VIII). At each steps of the modeling, teachers included students’ activities during learning process. Fig 4.6 presents the modeling approach.

![Diagram](image)

**Fig 4.5 Modified Proposed Mathematical Modelling Approach (Researcher).**
Figure 4.5 shows proposed but a mathematical modeling procedures that were used by experimental teachers in the study. The approaches were used in all the algebraic word problem content covered during the study (Appendix IX). Important objectives behind the used of the study were to promotes student understanding of the problem and guide their thinking in order to learn how to use the modeling procedures and apply the process to solve relevant word problems (Fostern, 2010). The use of procedures show how teachers guided the students toward getting solution to identified task or problems and this was used as follows:

i. Comprehension process. The arrow shows how leaners through the guidance of their teachers read the entire problem and picture what it’s about and rewrite the problem in a sentence form.

ii. Modeling process. The arrow indicated how the lesson teachers guided the learner determine who and what is involved, write down what the problem was talking about.

iii. Mathematical analysis. The arrows shows how the lesson teachers guided learner on how to set the word problem into an equation form, using relevant operation to enable them solve the problem.

iv. Interpretation process. Having obtained the solution, the learner make a careful observation to whether the solution make sense or not by representing real world situation and if not, the learner followed the same procedures until a correct solution was obtained.
v. Emulation or Encoding process. The arrow shows the comparison of the obtained solution and the model situation. In case the solution has not represent the situation model, the learner again followed same procedures until an accurate solution is obtain and then report through communication process.

In support of this direction, the new Common Core State Standards in Mathematics call for a greater emphasis on mathematical modeling as students’ would be assessed on their ability to solve a variety of open-ended problem types (CCSSM, 2010). Also in agreement with this direction was Omobude (2013) which in his study on Learning mathematics through mathematical model in Nigerian senior secondary school maintained that as students can write an equation from word a problem situation it enhances their proficiency of the text language.

4.6 Discussion of Results

The first objective was to established teachers proficiency level of English in teaching and learning algebraic word problem. The objective was guided by one research question that seek to establish the proficiency level of teachers in teaching and learning algebraic word problems. The study found out that forty percent (40%) of teachers used their knowledge of English to a very large extend to create an atmospheric condition in word problem class, this was an evident as only ten percent (10%) of teachers could not use knowledge of English to make the learning more conducive. Finding has also revealed that half (50%) of
teachers used their knowledge of English to encourage reading as processes in teaching and learning word problems.

Result from the study further revealed that forty percent (40%) of teachers used their knowledge of English to a very large extend to respond to students question in word problems. Percy & Andrew (2014) in support of this finding view that teachers proficiency of English as a Language in teaching and learning mathematics especially algebraic word problems provide a basis for teachers to make learners be successful in problem solving. Ball etal (2008) also in support of the findings revealed that teacher’s knowledge about the language of instruction and subject matter has a strong bearing on the content taught and how it is taught. It follows, therefore, that to teach algebra word effectively, a teacher must understand and know the algebra aspect that is to be taught.

Further findings has also indicated that thirty percent (30%) of teachers shows to a very large extent to which they use their proficiency of English in teaching word problems, while thirty percent (30%) of teachers in the same group could not use their proficiency level of English to help students identify keys words in the problem. This findings support Ladele (2013) where teachers were giving word problems solution made by jss1 in the beginning algebra, result indicated that about 30 % of teachers could not identify correct variables’ from students solution. The implication here is that Nigerian teachers may not carry all leaners along if their proficiency of English a language of instruction is not fully improve as it count very significance in leaners achievement in mathematics.
National Council of Teachers of Mathematics (NCTM, 2012) in a similar study on closing the opportunity gap in Mathematics Education, recommends that in carrying all learners along during mathematics lesson and especially algebra word problem lesson, teachers should emphasize class discussion, communication and reading habit as these will improve learners’ proficiency in both the text language and the language of instruction.

In support of the findings also was the case of Umar, one the experimental teachers from the experimental schools during the focus group discussion revealed that he was one of a teacher with traditional beliefs, who was selective in teaching word problems content and only based on the use of questions and students responses prior to the intervention. During the intervention which incorporates the use of the new strategy, Umar place emphasis on engaging students to read the problem, ask questions and participating in problem solving. He therefore placed emphasis on correct interpretation of word problems and with this Umar ability to teach word problems increased. The implication here is that teachers proficiency level of English can improve significantly if teachers involve in professional learning that seek to improve their proficiency level (Lesson Observation, 22/08/2015).

The second objectives were to determine teachers’ level of preparedness in algebraic word problem class. Result from the study found revealed that forty percent (40%) of teachers responded to very large extend to be prepared in explaining word and terms using simple expression in algebraic word problem
class, none (0%) of the teachers was not sure of his level of preparedness whereas thirty percent (30%) of the shows that they did not prepared at all in explaining terms and words using simple expressions. Result also revealed that half (50%) of teachers were found to be prepared to a large extend in developing simple vocabulary and terms in word, where thirty percent (30%) did not. This might be changes in teachers’ level of preparedness after the intervention. The findings agreed with the new direction for including mathematical modeling for improving problem-solving skills (Lesh & Zawojewski, 2007) and regarded as the most significant goals of mathematics education (Lesh & Zawojewski, 2007, Lesh & Sriraman, 2005). This also confined with the National Policy on Education (NPE, 2007) which suggests that the junior and senior mathematics curriculum should reflect changes that align with international reform movements.

Further findings also revealed similar responses where twenty percent (20%) of teachers were engaged in managing group activities in word problem class. This clearly shows that teachers were homogenous in their level of preparedness in terms engaging students in group activities in learning algebraic word problems. Result also revealed that half (50%) of teachers found to be engage in class discussion and interpretation during algebra word problems as only twenty percent (20%) could not where twenty percent (20%) of the teachers also were not sure of their prepared level while discussion and interpretation in word problem class. In assessing students while solving word problem questions,
half (50%) of teachers were found to be prepared to a large extend whereas also 20% could not.

Adeyemi (2008) in agreement with this findings viewed that teaching word problems is a complex task and demanding teachers preparedness that requires skill in management and making fast decision and communication that will lead to the mastery of the subject matter and psychological insight. One cannot be fully prepared in any mathematics class without acquiring professional learning. Therefore, the more teacher is prepared, the better the performance that can be expected of him/her. Esan (2015) in his study on Students’ Learning Outcomes in Algebraic Word Problems as teachers engage in modeling approach that involve mathematization in word problems to makes leaners model the problem to represent the real life situation, teachers must prepared and be equipped to a very large extend so as to achieve the intended objectives in algebraic word problem class.

Contrary to the above finding were Setati et. al.’s (2008) whose study aims at helping second language learners with this problem of comprehension of word problems by using the learners’ home languages as resources in the classroom offers versions of word problems in the learners’ home languages. They conclude that this strategy improves learners’ comprehension of the word problems and improve performance, however Kazima (2008) viewed that if the main objectives mainly focus on leaners comprehension of mathematical terminologies which can be achieve through the use of mother tongue, learners may find it difficult to
translate such terms in their mother tongue. The focus on learning word problems shouldn’t only be on mathematical terms, so teachers success in teaching and learning word problem is his or her ability to comprehend the text language and English as the language of instruction.

In the case of, Ruth one of the experimental teachers whose responses were part of those analyzed in the MTQs on teacher preparedness seemed to have become more English language-conscious during the teaching. In her response to question seven in focus group interview (Appendix VII) reported that, students learnt mathematics effectively through classroom discussions in which they were the focus during the teaching process. Ruth’s written reflection on mathematical talk was that it was important for improving students’ ability to understand how to interpret questions. She mentioned the importance of using familiar words to her colleagues during the intervention, she maintained that; ’Teaching should not be teacher-oriented, it should be student-center, we should not be using big words; we should use the words they are familiar with, simple ones, she stated that if teachers relate meanings with words in problems, it shows teachers readiness and ability to explained problem situation to students” (lesson observations 6/8/015).

Ruth also in support of the finding on teacher preparedness in algebraic word problem lesson further adopted the Newman interview procedure in her class by calling different students to answer each of the Newman questions (Appendix VI). For example, Ruth wrote on the board; A woman is 30 years old, what was her age in 10 years ago?. Ask the student as this,
Ruth: What would l be the first step?

Student: wrote total age of woman = 30 years now

Ruth: is that the answer?

Students: No, we find her age in 10 years ago

Ruth: What is ago students?

Students: ago means minus or subtraction

Ruth: show me how to subtract the age

Student: 30- 10 years = 20

Ruths: what was the womans’ age in 10 years ago?

Students: is 20 years old

Ruth: So, look at it now, (10 + 20 = 30) is this correct?

After the solution was written, Ruth asked the students to substitute and confirm the equality before she explained again ((Lesson observation, 27/08/2015)

The first hypothesis H₀₁ in the study was that there was no significance means difference on effects English language between students performance in teaching and learning word problems using mathematical modelling at junior secondary school level. The hypothesis was pre-tested and post-tested using the design of the study. Result revealed a statistically insignificant difference in the mean scores of pre-test MWPST for the experimental (E₁) and control groups (C₁) at t (203) =0.919, ρ = .326, α = .05 where p>0.05. Thus the hypothesis which stated that there was no significance difference on effect of English language on students’ performance using modeling in word problem at JSS2 was retained. This revealed
that the level of performance between experimental group E1 and control group C1 prior to the intervention was similar. This finding is to be expected since the students in the public schools have experienced one to two years of learning in English and therefore would have had limited English proficiency.

In support of this finding, Adetula’s (1989) in his study concerning Nigerian Primary 4 public and private school students revealed that the private schools can perform better on arithmetic word problems written in English while the students in the public schools can performed better when the questions were written in the native language (Adetula, 1990). In agreement with this finding also were Namasaka, Mondoh & Keraro (2013) who reported a pretest result that shows insignificance means difference in performance between control and experimental groups involve in the study. The implication was that that the two groups are homogenous in their learning abilities.

The pre-test MWST performance between male and female students was also statistically insignificant, at t (108) = 13.16, \( \rho = .240, \alpha = .05 \) where \( \rho > 0.05 \). Arthin & Offee (2015) in support the finding reported that there was no statistically significant difference in the pre-test mathematics achievement between male and female students from the experimental group. This is a clear indication that in most experimental research mathematic which always engages students in pre-test prior to the intervention are likely to have similar performance by students of both experimental and control groups. The assumption is that
students may have similar abilities in learning that subject matter before the intervention after which they are engage in posttest achievement test.

Results on MWPST posttest on the first hypothesis $H_0$ in the study which stated that there was no significance means difference on effects English language between students performance in teaching and learning word problems using mathematical modelling at junior secondary school level, the test of the means significance difference of students MWPST posttest using ANOVA, Scheffes Comaprism and independent sample t-test.

ANOVA results of MWPST post-test between the 4 groups revealed a significant means difference in the student performance, $F (417) = 48.63 \quad p = .01, \quad \alpha = .05$ where $p<0.05$. By implication result indicated that using mathematical modeling in learning algebra word problem increase students proficiency of English language as a language of instruction and the text language. The increase in the proficiency would also reflect in students performance. This findings agreed with David (2009) who found that there was a significant relationship between English language Proficiency and academic achievements in mathematics. This suggests that as English proficiency increases, so does academic success. Adegoke (2013) in his study on structural regression modelling of bilingualism and achievement in mathematics among senior secondary school students in Nigeria reported a similar finding. The structural model showed that the relationship between Proficiency in English language and mathematics achievement was high and
positive. This shows that as students’ proficiency in English language increases, achievement in mathematics is also likely to increase.

A Scheffe post hoc comparison test on the same H₀3 was also carried out. The hypothesis stated that there was no means significance difference on effect of English language between students performance using mathematical modeling result revealed that there was a statistically significant mean difference between the mean scores of the experimental groups E₁ and control group C₂ (ρ = .001).

The third hypothesis, H₀₃, that there is no significant difference on effect of English language between students’ performance using mathematical modeling was then rejected. This study agreed with findings of Wambugu & Egerton (2008) on their study on Effects of Mastery Learning Approach on Secondary School Students’ Physics Achievement, a Scheffe’s test revealed a significance difference between control groups and experimental groups (p= 0.01), α = 0.05, p<0.05). The implication here is that effect of English as language of instruction has increase in word problems through mathematical modelling.

To further test the hypothesis one as mentioned above, an independent sample t-test of post-test MWPST was also carried out using the same group of students. These groups (E₁, C₁, E₂ and C₂) were categorized into experimental group (E₁ and E₂) and control groups (C₁ and C₂). This is allowed in the design used in the study. The t-test post-test MWPST reveal that there was a significance difference in the mean scores in the posttest MWPST experimental groups and control groups, t(414)= 13.1, p=.001, α = .05, p <0.05. David (2009) carried out a similar
study on effects of English Language Proficiency as a Predictor of Academic Achievement among Students in Nigeria, his result revealed that the effect English language has also shown to be significant (F(1,198) = 18.0; P < .05).

Amina one of experimental teachers from female experimental boarding schools gave similar findings in her experiences during the focus group interviews about the professional learning. During a five weeks teaching period, one double and two single lessons which Amina taught were observed and recorded by the researcher. The most frequent lesson activities were: teacher using questions and identifying key terms; students doing board and individual work, and students asking questions. Amina often started with a written problem explaining each step as required by the strategy. Many students often volunteered to participate in solving problems on the board and sometimes two students solved the same problem on the board while she watched. The students at the board then explained the strategy they used in finding the answer and some of the other seated students were quick to point out errors, sometimes. Amina then adapted the Newman interview procedure in her class by calling different students to answer each of the Newman questions. For example,

**Problem1.** A girl is 12 years old. How old was she in five years ago? A student could not understand how “ago” transformed to “minus”.

Amina: How old are you?

Student: 10 years

Amina: How old were you five years ago?
Student: Five years

Amina: How do you know?

Student: I minus, 10 – 5 (Lesson observation, 16/8/2015)

After repeating the process with two other students, Amina explained that the word ‘ago’ referred to the past and meant subtraction for this question. The implication here was that Amin’s students overall success rate increased, success on symbolic and word problems increased by respectively. The frequency of comprehension errors was reduced and these were also observe in transformation and processing errors. As teachers engage in modeling process, students’ proficiency of the English language would increase and would have success in mathematics.

The implication of the above findings is that Mathematics teachers should Mathematical modelling approach in their teaching and learning of algebraic word problems. This is because the strategy was found to be more effective than the definition-only method. This strategy is learner centered hence it applies the 21st century pedagogy skills.

The second hypothesis $H_{02}$ in the study was that there was no significance means difference on effects of mathematical modelling based on gender performance in teaching and learning word problems at junior secondary school level. Result of the independent sample t-test revealed that there was a significance difference in the mean scores in the posttest MWPST between males and females experimental
groups \((t(207)= 20.20, \ p= .001, \ \alpha = .05, \ p <.05)\). This was a clear indication that both males and females performance in word problems have significantly increased through mathematical modeling. Njoroge& Githua (2013) gave a similar findings on students performance when exposed to cooperative learning modelling strategy, where the t-test MAT pos-test mean scores between male and female students was statistically significant, \((t (172) =3.65, \ p= .001, \ p<0.05)\).

Arthin &Offoe (2015) on their study on gender diffidence in mathematics achievement found a contrary opinion where the t-test values of the post-test scores in mathematics for the experimental group revealed that that there is no statistically significant difference in the mathematics achievement between male and female students from the experimental group \((t (39) = .82, \ p= .42)\). Yun (2001) who investigated gender differences in verbal (English language) and sciences (mathematical skills) among Chinese adolescent. His findings revealed that males scored higher than the females in mathematical skills. Joseph and Kurumeh (2011) on their study on the effect of two Problem-solving Models on the Nigerian Junior Secondary School Students’ Achievement in algebraic word problems for both experimental and control groups, the t-test posttest MPST revealed that there was a significance difference in means performance between male and female students in the experimental groups.

Adeleke (2007) in support of the above findingexamined problem solving performance of male and female students’ in word problems using conventional method and conceptual leaning strategy and procedural learning strategy, his
result revealed a significant difference ($t(37) = 0.82, p= .04, \alpha = .05, \ p<0.05$ ) in performance of males and females students in word problem when exposed to conceptual and procedural learning strategy then the conventional method. The implication here is that focusing on the process of making sense of a complex situation and modelling it mathematically can also help both males and females students focus on the ‘making sense’ aspect of word problems. Working with word problems in this way can give meaning to mathematics based on the student’s gender personal experience and can therefore make them active participants in their own learning as they use mathematics to model their own situations.

The last objective was to formulate a mathematical modeling approach in teaching and learning algebra word problem at junior secondary school level. In the development the modeling approach, prototype lesson was also formulated with aim of enhancing learners applied the strategy in their solution to word problem. The MMA approach is to promote student understanding of the problem and helps guide their thinking and modeling procedures in word problems (Forsten, 2010). According to Forsten (2010) and there are several benefits to the students using Forsten Mathematical modeling Approach, notable ones includes students ability to (1) read the entire problem (2) rewrite the question in a sentence form, stating the problem in a situation model (3) setting the problem in an model form (4) solving the problems (5) correctly computing and getting solution to the problem (6) and finally writing the answer in the sentence form and make sure the answer makes sense.
4.7 Chapter Summary
This chapter has presented the research findings, their interpretation and discussed them in relation to other studies concerning effects of English language and students achievement in Mathematics. It also presents and discusses a prototype of a lesson plan for Mathematical Modelling based instructions as well as a developed Mathematical Modelling Approach for learning mathematics at junior secondary school level. The next chapter contains the summary of the research findings, conclusions and recommendations for further study.

CHAPTER FIVE
SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction
This chapter summarizes the findings of the study. It also presents the conclusions and recommendations from the findings. Additional research areas have also been given. The implications of the study at various levels have been outlined.
5.2 Summary of the Findings

The study was conducted for the purpose of establishing the effects of English language as a second language on students’ performance in the teaching and learning of mathematical modeling among junior secondary school students. The study was a non-equivalent quasi experimental design with emphasis on Solomon Four group design. It was conducted in Southern Educational Zone of Bauchi State, Nigeria. The study sampled four hundred and twenty (420) JSS2 students in the four selected Boarding schools from the study area. The four boarding schools were two boys boarding and two girls’ boarding schools respectively. The study also used ten (10) teachers of which five were trained from the two experimental schools and used as experimental teachers, while the other five remain as control teachers from the two control boarding schools.

The training of experimental teachers on the new strategy (MMA) lasted for a period of two weeks. The experimental groups in both schools were taught mathematical modeling approach in algebraic word problems. This was used by experimental teachers in teaching and learning word problem during the treatment. The treatment period lasted for a period of five (5) weeks during the third term in the school year 2015. The control group taught word problem using normal or conventional approach. Data was collected using one achievement tests for students and one set of questioner for mathematics teachers. The study was guided by the following five (5) objectives; (1) To establish teacher’s proficiency level of English as a second language in teaching and learning of JSS2 algebraic
word problems. (2) To determine teacher’s preparedness in their use of English in teaching and learning JSS2 algebra word problems (3) To find out the effect of English Language on JSS2 performance in word problems through mathematical modeling (4) To find out the effect of mathematical modeling on gender performance among junior secondary schools students (5) To formulate mathematical modeling approach that would enhance junior secondary school students performance in word problems.

The first objective of the study was addressed by the research question one. The research question was that; what was the level of teachers’ proficiency level of English in teaching and learning algebraic word problems? The study found out that there was increased teacher’s level of proficiency of English as a language of instructions in teaching and learning word problems. The increased was revealed as half (50%) of teachers were found to encourage reading process in teaching and learning word problems. Reading process is one of the basic components in the comprehension process in mathematical modeling approach (Forsten, 2010). Also 40% of teachers were found to sustain students’ interest in word problems as they were able to respond positively to students question in word problem class.

The second objectives of the study was addressed by the second research question which stated that, what was the teachers level of preparedness in teaching and learning word problems? It was found that (40%) of teachers reported to be prepared to the large extent that they used simple algebraic expression in explaining word problem concept for easy comprehension by the learners. Further
findings also revealed that also half (50%) help student develop vocabulary which are English words but with mathematical meaning. Also fifty percent (50%) of the same teachers found to include discussion with students in solution to word problem so as to get students proficiency of the text language.

The third objective of the study was addressed by the research hypothesis one (H₀₁) which stated that, there was no significant means difference in the effect of English on students’ performance in word problem using mathematical modelling approach. The study found out that there was a significant means difference (F (417) = 48.63 p = .01, α = .05 where p<0.05 t(414)= 13.1, p= .001, α = .05, p <0.05, ) between experimental group and control groups on effect of English language based on performance in post-test MWPST. TheScheffe post hoc test thus also revealed a means significant difference ((p= 0.01), α = 0.05, p<0.05) between experimental groups and control groups. The implication here is that integrating mathematical modeling approach in word problem class, students proficiency of both English as a language of instruction and the text language would increase significantly.

The second objective of the study was addressed by the research hypothesis two (H₀₂) which state that, there was no significant difference on effects of mathematical modeling on students’ performance based on gender. The study found that there was significant means difference (t(207)= 20.20, p=.001, α = .05, p <0.05) on effect of mathematical modeling on performance between males and females d students’ of experimental groups. These findings revealed that
mathematical modeling is central to overall successful performance of students and therefore should be integrated as a strategy in teaching and learning algebraic word problem.

In general the following is a summary of the main research findings:

i. There was an increased in teachers proficiency level of English as a language of instruction in algebraic word problem class.

ii. There was a positive increased in teachers’ levels of preparedness in teaching and learning algebraic word problems.

iii. There was a positive significant increase on effect of English language on students’ performance in word problems through mathematical modeling approach.

iv. There was a positive significant increased on the effect of mathematical modeling on students’ performance based on gender.

v. The Mathematical Modelling approach which is the most effective strategy for teaching and learning word problem among second language learners have been developed.

5.3 Conclusions

Following the above findings, the study made five (5) important conclusions. First, the study concluded that there is a positive change in teachers’ proficiency of level English language as they integrate modeling in teaching and learning word problems.
Secondly, the study concluded that a well-developed, planned and executed algebra word problem instruction can significantly improve students’ achievement in Mathematics.

Third, an effective mathematical modeling instruction can be used to promote Students’ interest in word problems and general Mathematics as a whole. As this would make teachers prepared fully since the strategy is more of students centered rather than teacher centered.

Fourth, as the strategy enhances students (second language learners) performance in word problem so is their proficiency level of the English language would be better improved and even compute with the first language learners in mathematics classroom.

The fifth conclusion was that the simple mathematical modeling instruction developed can be used to enhance deeper understanding of the text language and English which is the language of instruction.

The thesis of the study was that proficiency of English language is a significant factor in Mathematics comprehension. Students’ proficiency of English is a challenge which makes them difficult to comprehend the text language in word problems. These are also English written statement which requires proficiency of the language. The Mathematical Modelling approach was shown by this study to
be an effective way of teaching and learning algebraic word problems at junior secondary school levels.

5.4 Recommendations

From the conclusions of the study, recommendations were made and areas of further study were suggested.

i. Teachers should emphasize the use of mathematical modeling approach in their JS 2 algebraic word problem content, to change pedagogy and to provide assessment that focuses more on understanding than on mastery of algorithms. Students need more time to understand algebraic word problem concepts, and this study was unable to correctly answer some of the questions because they required a deeper level of understanding.

ii. The Junior Secondary Levels Mathematics textbook writers should be sensitized on the effects of English language on students learning of Mathematics. They should lay emphasis on the exposition of mathematical vocabulary in their textbooks before their use in mathematical text and questions. They should use mathematical modeling approach in explaining the terminologies that learners would encounter in every section of their textbook. This would enhance students’ understanding of Mathematics.

iii. Mathematics teachers should use the strategies that can be used to enhance students’ proficiency of English as a language of instruction in word problem class. The integration of Mathematical Modelling approach is the
best method since it is learner centered, it would enhance deep proficiency of the text language and lead to relational understanding of mathematical concepts.

iv. Understanding and solving word Problems through Mathematical Modelling supports English Limited Language (ELL) students with the additional feature of cooperative learning. “Guide individual, small-group, and whole-class work. Students first study the modeled and then try it on their own with the model available for reference. The mathematics teachers therefore should guide students through individual, small-group, and whole-class activities.

v. The Junior Secondary School Certificate Examination (JSSCE) and other examination bodies should take into account the issues of students’ proficiency of English language in setting Mathematics items.

5.5 Recommendation for further research

The study recommends further study on the following:

i. Effects of English language proficiencies on students’ performance in Mathematics.

ii. Effect of Mathematical Modelling on students’ performance in word problems based on gender.

iii. Impact of teacher qualifications, attitude and school factors on students’ performance in Mathematics.
iv. The effectiveness of Mathematical Modelling lessonplan in word problems.

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APPENDICES

APPENDIX I

Consent Form for Mathematics Teachers

Title of Project: Effect of English Language on students performance in teaching and learning of mathematical modeling at junior secondary school level.

I have read the information above regarding the research and all questions I have been asked to answered to my satisfaction. I am aware that I can contact the student, his/her supervisor or the Research Ethics Officer if I have further
questions or concerns. I understand that I may withdraw from the study at any time.

**Instructions**

Teachers will be required to tick the boxes below to indicate your willingness to participate in various aspects of the study.

I am willing to complete the initial teacher questionnaire. □

I am willing to attend the one week of training workshops, participate in the group discussion and complete the second questionnaire. □

I am willing to have my algebra (on word problems) class observed, my class to complete the algebra test and for five students to be interviewed before and after the workshops □

I agree to having my voice recorded and photographs of mathematics problems solutions taken in my class □

I also agree that the research data gathered for this study may be published provided that I, my school and Local Education District are not identified □

**Participant Name:**

_____________________________________________________

Signature:__________________________________ Date: ________________

**APPENDIX II**

**Mathematics Teachers Questionnaire**

This questionnaire is designed to find data on teachers’ proficiency level of the language of instruction in mathematics classroom. The questionnaire will further find data on teachers preparedness (strategies) in teaching and learning algebra word problem in Bauchi State, Nigeria. The information will strictly be used for
the purpose of this research. Please tick (√) in the box appropriate to your response. All information provided will be treated confidentially.

SECTION A: Demographic Data
1.1 Gender: Male.  Female.  

1.2 Local Education District: ________________________________

1.3 Name of School: ________________________________

1.4 Age (years)  21-25 □  26-30 □  31-35 □  36+ □

41-45 □  50-55 □  60+ □

1.5 Completed years of mathematics teaching experience: 0-3 □  4-7 □  8-11 □  12-15 □  16-19 □  20+ □

1.6 Completed years of JSS two teaching experience: 0-3 □  4-7 □  8-11 □  12-15 □  16-19 □  20+ □

1.7 Please tick boxes to indicate all of your qualifications: NCE □  B. Sc.Ed □  B.sc. □  M.Ed /M. Sc □  Others please specify): ________

1.8 Subject Specialist (Combination): ________

1.9 Please write the name and average class size of each Basic 8 arm you teach in the respective boxes

<table>
<thead>
<tr>
<th>Name of arm</th>
<th>Class size</th>
</tr>
</thead>
</table>

1.10 Number of mathematics /mathematics teaching workshops, seminars or trainings attended in the past 2 years: ____________
SECTION 2: Please write your answer to these questions in the spaces provided below

2.1 What medium of instruction can facilitate and improve effective teaching and learning of mathematics in junior secondary level?

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

2.2 Which language do you mostly use to teach Algebra word problems? Why?

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

2.3 What challenges do you face in teaching junior secondary school mathematics effectively particularly on word problems?

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

2.4 What difficulties did you experience when teaching Algebra word problems in English as a second language? Why?

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

2.5 What aspect of word problem that is more difficult to teach in the junior secondary mathematics?

________________________________________________________________________

2.6 How does the knowledge of English help you in teaching and learning in the mathematics classroom? Tick the option, to a very large extend (A), to a large extend (B), not sure (C), to a small extend (D), not at all (E) in each item. Tick the option you agree with for each item
1. My knowledge of English helps me in establishing a classroom atmosphere in which students develop confidence to respond to my questions.

2. My knowledge of English in teaching and learning of word problems helps me having students reading aloud the question to be solved.

3. My knowledge of English in teaching and learning mathematics enables me respond to students’ answers to my questions.

4. My knowledge of English helps me in asking students to identify key words and symbols in the question.

5. I am effective in using English to ask questions in order to identify students’ level of understanding prior knowledge of mathematics topics.

6. I am able to sustain students interest in word problem using native language.

2.7 How prepared are you in using English as a Second language to teach algebra word problems? (Tick a box for each item)

<table>
<thead>
<tr>
<th>Items</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Explaining algebra concepts using simple expression</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 Developing vocabulary and terms needed for learning algebra word problems</td>
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</tr>
<tr>
<td>3</td>
<td>Managing group activities in algebra word problems</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Engaging students’ interest in algebra word problems</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Managing discussions and interpretations of word problems</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Assessing children learning algebra of through their misconception word of word problems</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**APPENDIX III**

**Classroom Observation Schedule**

School Name: ...........................................Topic:...........................................

Teacher Name: ....................................................Gender:.........................
Qualifications:........................................Grade Level.................................

Number of learners: ........................................Observer Name: ......................

Date of observation:.................................................................

<table>
<thead>
<tr>
<th>Activities</th>
<th>Time Interval</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>(1) Identifying variable and misconception (2) identifying key terms and symbols (3) reading aloud of the question (4) reframing question in own words (5) explaining strategy for solving problem (6) finding the value of the letter (if applicable) (7) writing the answer (8) individual group work (11) note copying.</td>
</tr>
<tr>
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<td></td>
<td></td>
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<td>9</td>
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<tr>
<td>10</td>
<td></td>
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</tbody>
</table>

APPENDIX IV

Mathematics Word Problem Solving Pre-test Questions

Instructions

Students are required to write their exams number on the answer sheet provided. You should answer all the questions on your answer sheets. Remember to write how you arrive at your answer clearly.
1. I think of a number, 7 added to the number gives 9. What number am I thinking of?

2. A woman is 30 years old, what was her age in 10 years ago?

3. Gambo is 4 years older than Sadiq. Basira is 5 years younger than Sadiq. How old is Gambo when Sadiq is 15 years.

4. Mary has 20 oranges. Naomi has x oranges less than Mary. How many oranges has Naomi?

5. If $s$ is the number of students and $t$ is the number of tables, write in algebra: There are three students for every table.

6. If $d$ is the number of dogs and $c$ is the number of cats, write in algebra: There are four more dogs than cats.

7. A squirrel made a pile of nuts. It carried away 55 nuts up to its nest. Now, there are 38 nuts in the pile. How many nuts were in the pile at the beginning?

8. Farmer Usman has 88 animals on his farm. He only has horses and goats. There are 49 horses on the farm. How many goats are on the farm?

9. Adamu saw a pine tree in the forest. Later, he saw a maple tree that was 9 feet tall. The maple tree was 5 feet shorter than the pine tree. How tall is the pine tree?

10. A student has x sweets. She gives 20 to her friends. Find the original number of sweets.

APPENDIX V

Mathematics Word Problem Solving Posttest Questions

The students will be asked to answer the questions in the space provided after each one. Remember to write how you arrive at your answer clearly.
1 Farmer Usman has 88 animals on his farm. He only has horses and goats. There are 49 horses on the farm. How many goats are on the farm?

2 Gambo is 4 years older than Sadiq. Basira is 5 years younger than Sadiq. How old is Gambo when Sadiq is 15 years.

3 If $s$ is the number of students and $t$ is the number of tables, write in algebra: There are three students for every table.

4 I think of a number, 7 added to the number gives 9. What number am I thinking of?

5 A ball costs ten naira and a shirt costs $y$ naira more than the ball. How much does the shirt cost?

Solution:

6 A student has $x$ sweets. She gives 20 to her friends. Find the original number of sweets.

7 A woman is 30 years old, what was her age in 10 years ago?

8 Mary has 20 oranges. Naomi has $x$ oranges less than Mary. How many oranges has Naomi?

9 Craig saw a pine tree in the forest. Later, he saw a maple tree that was 9 feet tall. The maple tree was 5 feet shorter than the pine tree. How tall is the pine tree?

10 Write in algebra: There are twice as many books as pens (let $b$ be the number of books and $p$ be the number of pens).

APPENDIX VI

Newman Interview Protocol

Newman Interview Questions to be used with Students

1. Please read the question to me. If you don’t know a word or number, leave it out.
2. What does this sign/word mean? Tell me, what is the question asking you to do?

3. Show me how you start finding an answer to this question.

4. Show me how you work the answer out for this question. Tell me what you are doing as you work.

5. What is your answer?

APPENDIX VII

Focus Group Interview Questions

1. What difficulties can a student encounter in solving word problems?

2. What kind of misconceptions did your class committed? How did you handle it?
3 Why are variables, expression and equality important in algebra
4 Which aspect of word is more difficult to solve by the students?
5 What makes some teachers not having the interest of teaching some aspect of word problems?
6 What makes students see word problem difficult to solve compare to a other algebra problem?
7 How will help students who cannot read the question proper?
8 What other methods are suitable for solving word problems?

APPENDIX VIII

Lesson plan with Template (MMA)

SUBJECT: Mathematics
REFERENCES: Junior Mathematics (NGM)

CLASS: JSS2

<table>
<thead>
<tr>
<th>Date/Time</th>
<th>Topic/</th>
<th>Objectives/Teaching/Learning Materials</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Subtopic PK  Keywords/English terms  Learning outcomes

Teacher/Learner Activities

Unit 4  Objectives

English terms: ago, older, younger etc

17/10/016  By the end of the lesson

learners would be able to:  Introduction (5mins)

Topic:  i. find age Teacher gives the following problem

Tuesday  Word problem Problem 1

Problems in terms of Osman is 3 years older than

Addition & Mohammed. Leyla is 5

8:00am  Subtopic Subtraction years younger than Mohammed.

to  Age word How old is Osman when Mohammed

8:45am  problems is 10 years?

P.K. Activities

Step 1 (3mins)

Addition and The teacher read and ask the student Comprehension

of Subtraction read the question repeatedly (ability to read)

word problems

Step 2 (5 mins) Ability to

The teacher guide the students transform the

brings the unknowns variables unknown

such that Mohammed = x

Step 3 (10 mins) Ability to

Osman age will be x+3 (older) model or

193
Levla age will be x-5 (younger) and mathematise and represent

Step 4 (15 mims)

The teacher guide the student Ability to toward solving the problem use correct operation

Osmond age x+3 = 10 +3 since x= 3
Osmand age now = 13

Step 5 (2mins)
The teacher guide students to proof their Ability to answers evaluate

Conclusion/Evaluation (5mins)
The teacher give class work to find
ages of each as appeared on fig above

---

**APPENDIX IX**

**Curriculum Matching Chart (Word Problems, Jss2)**

<table>
<thead>
<tr>
<th>Weeks</th>
<th>Content</th>
<th>Objective</th>
<th>Teachers activities</th>
<th>Students activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Integer word proble</td>
<td>Identify the basic operations in the problem use</td>
<td>Explain the language of the problem by using</td>
<td>Use the relevant modeling to solve word problems on</td>
</tr>
<tr>
<td></td>
<td>ms</td>
<td>correct modeling</td>
<td>the mathematical integer</td>
<td>integer</td>
</tr>
<tr>
<td>---</td>
<td>------------------------</td>
<td>----------------------------------------------------------------------------------</td>
<td>------------------------------------------------------------------------------------------</td>
<td>----------------------------------------------------------------------</td>
</tr>
<tr>
<td>2</td>
<td>Fraction word problems</td>
<td>Identify the parts and the whole and form a linear equation</td>
<td>Explain the components developing an equation.</td>
<td>Apply the relevant equation to solve problems</td>
</tr>
<tr>
<td>3</td>
<td>Proportion word problems</td>
<td>Identify the items in the sentence which are proportional to each other</td>
<td>Explain how the value of one item changes using a mathematical modeling</td>
<td>Give the students class work with similar problems</td>
</tr>
<tr>
<td>4</td>
<td>Ratio word problems</td>
<td>Write the items in a ratio form using mathematical modeling</td>
<td>Formulate a correct modeling</td>
<td>Use the correct modeling to solve similar ratio problems</td>
</tr>
<tr>
<td>5</td>
<td>Age word problems</td>
<td>Comprehend ages in the present, past and the future</td>
<td>Represent ages in equation</td>
<td>Solve relevant age word problems using modeling</td>
</tr>
</tbody>
</table>
APPENDIX X

Map of Nigeria Showing Bauchi State (Study area)

Source: http://www.nigeriamasterweb.com retrieved 24/9/015
APPENDIX XI
Approval of Research Proposal

KENYATTA UNIVERSITY
GRADUATE SCHOOL

E-mail: dean-graduate@ku.ac.ke
Website: www.ku.ac.ke

P.O. Box 43844, 00100
NAIROBI, KENYA
Tel: 810901 Ext. 57530

FROM: Dean, Graduate School.

TO: Mr. Dogo Peter
C/o Educational Communication and
Technology Dept.
Kenyatta University

DATE: 23rd June, 2015

REF: E857/28974/2013

SUBJECT: APPROVAL OF RESEARCH PROPOSAL

This is to inform you that Graduate School Board at its meeting on 17th June, 2015 approved your Research Proposal for the Ph.D. Degree. Entitled “Effect of English Language on the Teaching and Learning of Mathematical Modelling at Junior Secondary School Level in Bauchi State, Nigeria”.

You may now proceed with data collection, subject to clearance with the Permanent Secretary, Ministry of Higher Education, Science and Technology.

As you embark on your data collection, please note that you will be required to submit to Graduate School completed Supervision Tracking forms per semester. The form has been developed to replace the progress report forms. The supervision Tracking Forms are available at the University’s website under Graduate School webpage downloads.

By copy of this letter, the Registrar (Academic) is hereby requested to grant you Substantive registration for your Ph.D. studies.

Thank you.

JULIA GITU
FOR: DEAN, GRADUATE SCHOOL

cc. Chairman, Educational Communication & Technology Dept.
Registrar (Academic)

Supervisors:
1. Dr. Miheso O’Connor
C/o Department of Educational Communication & Technology
Kenyatta University

2. Dr. Samson Renana Ondigi
C/o Department of Educational Communication & Technology
Kenyatta University

24 JUN 2015
APPENDIX XII

Research Authorization

KENYATTA UNIVERSITY
GRADUATE SCHOOL

P.O. Box 43844, 00100
NAIROBI, KENYA
Tel. 8710901 Ext. 57530

E-mail: dean-graduate@ku.ac.ke
Website: www.ku.ac.ke

Our Ref: E837/28974/2013

DATE: 23rd June 2013

Bauchi State,
Ministry of Education,
Private Bag,
BAUCHI

Dear Sir/Madam,

RE: RESEARCH AUTHORIZATION FOR DOGO PETER—REG. NO.
E837/28974/2013

I write to introduce Mr. Dogo Peter, who is a Postgraduate Student of this University. He is registered for PhD degree programme in the Department of Educational Communication & Technology.

Mr. Dogo Peter intends to conduct research for a PhD Proposal entitled, “Effects of English Language on the Teaching and Learning of Mathematical Modeling at Junior Secondary School Level in Bauchi State, Nigeria”.

Any assistance given will be highly appreciated.

Yours faithfully,

MRS. LUCY N. MABARI
FOR: DEAN, GRADUATE SCHOOL