PEDAGOGIC STRATEGIES INFLUENCING PUPILS' LEARNING OF ALGEBRAIC CONCEPTS IN UPPER PRIMARY SCHOOL CLASSES IN LAIKIPIA WEST SUB-COUNTY, LAIKIPIA COUNTY, KENYA

BY

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A RESEARCH THESIS SUBMITTED IN PARTIAL FULFILMENT OF THE AWARD OF MASTER OF EDUCATION DEGREE IN THE SCHOOL OF EDUCATION OF KENYATTA UNIVERSITY

MARCH 2017
DECLARATION

I declare that this is my original work and has not been presented either partially or wholly for a degree in any other University for any academic programme in any institution or University. All the work that I have used or quoted has been dully acknowledged.

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DEDICATION

I dedicate this thesis to my family, my dear wife Teresa and above all, my dear son Brian and daughters Bridget and Candice.
ACKNOWLEDGEMENTS

I sincerely acknowledge all the people who made it possible for me to complete this work. My patient and understanding supervisors: Dr. Simon M. Rukangu and Dr. Wilson K. Kerich who guided me through this work, not withholding their invaluable knowledge and expertise. Prof. Kisilu Kombo, Prof. Leo Odongo, Prof. Ondigi, Dr. Miheso K. Marguerite, Dr. Florence Nyamu and Dr. Charity Limboro for their invaluable critique of this work. I pay special attribute to lecturers and staff in the School of Education Kenyatta University. To my dear family, I say thank you for the encouragement, patience and understanding during the entire period of study. I would also not forget my dear parents who, in addition to their prayers, never got tired of reminding me to finish up this thesis. I hope the best for them and that this scholarly work will ignite a spark of inquisitiveness in each of them to conquer all the impossibilities both current and future.

I would also not forget to thank my sub-County Director of Education Mr. Jacob Ireri, his Deputy Mr. John Gachago, the sub-County Director Teacher Management, Mr. Richard Lekupe, and Human Resource Personnel manager Mr. Bennedict Lentumunai. To all and many others, I say God bless you. Finally, thanks to the Almighty God for giving me sufficient grace.
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<tr>
<th>Acronym</th>
<th>Full Form</th>
</tr>
</thead>
<tbody>
<tr>
<td>KCPE</td>
<td>Kenya Certificate of Primary Education</td>
</tr>
<tr>
<td>KICD</td>
<td>Kenya Institute of Curriculum Development</td>
</tr>
<tr>
<td>KNEC</td>
<td>Kenya National Examinations Council</td>
</tr>
<tr>
<td>LD</td>
<td>Learning Disability</td>
</tr>
<tr>
<td>NCTM</td>
<td>National Council of Teachers of Mathematics and Standards</td>
</tr>
<tr>
<td>NMAP</td>
<td>National Mathematics Advisory Panel</td>
</tr>
<tr>
<td>PBL</td>
<td>Problem Based Learning</td>
</tr>
<tr>
<td>PCK</td>
<td>Pedagogical Content Knowledge</td>
</tr>
<tr>
<td>SPSS</td>
<td>Statistical Package for Social Sciences</td>
</tr>
<tr>
<td>TSC</td>
<td>Teachers Service Commission</td>
</tr>
<tr>
<td>LW</td>
<td>Laikipia West</td>
</tr>
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</table>
ABSTRACT

This study was aimed at establishing the pedagogic strategies influencing pupils’ learning of algebraic concepts in upper primary school classes in Laikipia West sub-County, Kenya. The three objectives of the study were to establish; (i) the widely used pedagogic strategies in teaching algebra; (ii) the factors influencing the teachers’ choice of pedagogic strategies in learning of algebra; and (iii) the pedagogic strategy that contributes most to pupils’ learning of algebra in upper primary classes. In Kenya, researchers in the past have addressed the cause of poor performance in Mathematics at national level in Kenya Certificate of Primary Education but have not addressed the pedagogic strategies applied in teaching and learning of algebra in upper primary classes in Kenya with particular focus on Laikipia West sub-County. The researcher used a descriptive survey design. Descriptive survey included both qualitative and quantitative in data collection to obtain responses from both Mathematics teachers and pupils in the upper primary school classes where algebra is mostly taught. The target population was 85 primary schools and 581 trained teachers in Laikipia West sub-County. First stage sampling included a simple random sample to select 17 schools representing 20% of target population to ensure all categories in the population is represented. Two trained Mathematics teachers from each school teaching standard seven class were purposively selected. Moreover, simple random sampling was used in selecting two hundred and sixty (260) class seven pupils following their class registers. Data was collected through questionnaires for both teachers and pupils; achievement test for pupils, observation schedule and interview schedule were administered to Mathematics teachers. The research instrument was piloted to enhance the validity and reliability. The achievement test was used to test pupils’ competence in algebra guided by the syllabus approved by the Ministry of Education. Data obtained was analyzed using statistical package for social science (SPSS version 22.0). The study revealed that there was significant difference in the pedagogical strategy used by teachers (F = 427.53, P = 0.0001). Cooperative learning was the most used strategy. The most effective pedagogical strategies that contributes to pupils’ learning of algebra, was similarly found to be cooperative strategy, ($\chi^2 = 29.001$, P = 0.031). The study, therefore, concluded that poor performance in algebra by students can be attributed to lack of active participation in the Mathematics classroom.
CHAPTER ONE
INTRODUCTION AND BACKGROUND OF THE STUDY

1.0 Introduction
This chapter contains the background to the study, statement of the problem, purpose of the study, the study’s objectives, research objectives and significance of the study, the study’s scope, and limitation of the study, assumptions, conceptual and theoretical frameworks and operational definitions of terms.

1.1 Background to the Study
Mathematics is considered one of the fundamental subjects for any school curriculum and for the future of any nation (Cockcroft, 1982). Algebra is one of the branches of Mathematics that uses mathematical statements to explain relationships between variables and time. It solves mathematical problems that are in form of symbols which can be built by students due to their experience with numbers (Cockcroft, 1982).

According to the NCTM (1989), algebra is used in most mathematical problems. Students apply algebraic functions in Mathematics in their daily life due to the need to have a highly-sophisticated knowledge of the representations as used in algebra. Quantitative methods are often used in other social disciplines such as sociology, psychology, economics and natural sciences. Due to this, algebraic knowledge is often needed not only in Mathematics but also in the above-named disciplines (NCTM, 1989).

Blanton and Kaput (2005), state that learners develop their early algebraic reasoning in the primary schooling. Warren and Cooper (2008) further note that algebraic reasoning in
the lower primary classes is not only about thinking about algebra but also having a structural perspective in regard to looking at the Mathematics numbers. The integration of algebra in the primary schools is important as it increases power, depth and coherence to the Mathematics taught in schools and also prepares the students to advanced algebra taught in later stages of future a student’s life (Kaput, 2007). According to Cockcroft (1982), primary school algebra is more accepted by students and more emphasis has been made on early algebraic reasoning and patterning in both lower classes and pre-primary schools. Further, Carraher, Schliemann, Brizuela & Earnest (2006) states that, despite being introduced in early stages of learning, algebraic concepts taught in the upper primary school classes have influenced their learning of algebra. The awareness of structural relationships of patterns helps learners to develop algebraic thinking early in their lives and later helps them grasp the complex structures of arithmetic (Carraher, Schliemann, Brizuela & Earnest, 2006). School students can be engaged in algebraic activities such as; simplifying algebraic expressions, substitution and writing expression that provide them with the opportunity to practice other advanced thinking skills for instance the generalization skills (Kaput, Carraher, & Blanton, 2007).

Kaput (2008) on longitudinal view of algebra, sees algebra as problem solving and thinking skills that are developed in lower primary schooling and later improved further in the upper primary school. When students seek out and connect the generalities in measurements, geometry, numbers and algebraic thinking, pedagogic strategies used in the teaching of algebra such as expository and heuristic can be the unifying factor for both the primary and secondary school level Mathematics curricula. Van Amerom (2003)
argued that students can acquire algebraic concepts before studying formal algebra through solving nonstandard problems.

Algebra is an important link of the basic algebra content learnt in primary school curriculum to the more advanced secondary school Mathematics which include; quadratic equations, calculus and trigonometry. Arcavi (2008) observes that algebra as a branch of Mathematics is often intimidating to middle level students and affects their attitude negatively in regard to Mathematics. A US Department of Education (2008) report entitled, *Foundations for Success*, shows that most of the drops in Mathematics grades were observed during middle school when algebra was introduced to students. Further, the inclusion of algebra in primary school does not imply adding traditional algebra to the school curriculum; rather, it means providing entry points for algebra through treating existing topics in a deeper and more connected way (Kaput, Carraher, & Blanton, 2007).

NCTM (2000) report shows that patterning activities can help students move towards understanding functional relations. Rich problem contexts can play an indispensable role, as experience and reasoning in some situations may support students in generating abstract knowledge (Carraher & Schliemann, 2007).

Cockcroft report (1982) suggested that efforts should be made to discuss some algebraic ideas with all the students. It is important for students in primary schools to learn Mathematics from well trained teachers. Enrolling for more advanced Mathematics classes is not the solution to understanding the teaching of Mathematics for the students (Reys and Fenell, 2003). It is important for the teachers to understand how their students learn the Mathematics content; they must also be able to make use of instructional tools
to teach Mathematics to the students (Hill, Rowan, and Ball, 2005). Cockcroft (1982) concluded that for those of average attainment only some simple algebraic work on formulae and equations which involves symbolization is desirable and that formal algebra is not appropriate for lower attaining pupils.

Algebra helps prepare students for the job market and also prepare them for the advanced inadequate time given for the learners to study on their own and concepts used in post-secondary learning (NCTM, 2000). Research conducted on algebra to investigate the pedagogical practices led to better student results in Mathematics (Anthony and Walshaw, 2008). Subsequent research study in Kenya by Eshiwani (2001) and Miheso (2002) identified factors that are believed to cause poor performance in Mathematics such as: poor methods of teaching, lack of modeling activities, use of advanced mathematical language and inadequate time given for the learners to study on their own. These studies have shown that the success of any educational reform lies in its ability to come up with new pedagogical identities, which is inclusive of setting up new educational trends and the imparting of new knowledge to both the students and the teachers. Despite these studies having focused largely in secondary school level, the determination of the teaching of algebra in primary schools in Kenyan context is imperative but lacking opportunities to express algebraic ideas to construct knowledge.

In Kenya, Mathematics is among the compulsory subjects in primary schools. The performance at national level has been generally poor in the recent years, but worst performed in algebra which is taught early in primary schools, (KNEC, 2010). Algebra is
particularly challenging to students owing to the poor teaching skills. Report from Kenya National Examinations Council 2010 shows that, KCPE performance in Mathematics has been very poor for the last nine years from (2006-2014), (KNEC Report 2014).

**Table 1.1: Candidates’ Mathematics performance in KCPE in selected years.**

<table>
<thead>
<tr>
<th>Types of questions</th>
<th>No. of questions</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
<th>2014</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arithmetic</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(a)mechanical</td>
<td>9</td>
<td>54.04</td>
<td>55.57</td>
<td>21.51</td>
<td>59.24</td>
<td>67.37</td>
<td>38.59</td>
<td>76.10</td>
<td>68.34</td>
<td>58.15</td>
</tr>
<tr>
<td>(b)applied</td>
<td>24</td>
<td>52.66</td>
<td>29.39</td>
<td>41.71</td>
<td>45.99</td>
<td>50.31</td>
<td>42.62</td>
<td>42.36</td>
<td>45.19</td>
<td>42.56</td>
</tr>
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<td>Data from table</td>
<td>3</td>
<td>56.00</td>
<td>43.38</td>
<td>43.25</td>
<td>39.21</td>
<td>64.33</td>
<td>63.09</td>
<td>44.82</td>
<td>58.90</td>
<td>52.84</td>
</tr>
<tr>
<td>Geometry</td>
<td>8</td>
<td>45.96</td>
<td>46.19</td>
<td>40.64</td>
<td>46.28</td>
<td>54.75</td>
<td>49.82</td>
<td>67.84</td>
<td>47.22</td>
<td>56.79</td>
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<td>55.31</td>
<td>37.44</td>
<td>52.41</td>
<td>52.53</td>
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<td>47.96</td>
<td>33.47</td>
<td>47.48</td>
<td>48.92</td>
</tr>
<tr>
<td>Algebra</td>
<td>4</td>
<td>42.64</td>
<td>37.77</td>
<td>42.49</td>
<td>41.18</td>
<td>53.05</td>
<td>44.41</td>
<td>50.51</td>
<td>47.93</td>
<td>47.50</td>
</tr>
</tbody>
</table>

**Source:** KNEC 2014.
Learners’ performance on algebra in the 9 years

Figure 1.1: Student K.C.P.E Performance in Algebra 2006 – 2014

Based on the secondary data on the students’ K.C.P.E performance 2006 – 2014, there has been overall increase in the performance in Algebra at a regression $R^2$ value of 42.3%. The above table also indicates that candidates might have experienced problems with questions item from topic on Algebra scoring below an average mean mark of 50% from year 2006 to 2014. Algebraic concepts are also applied in geometry and its poor performance for nine consecutive years from the year 2006 to 2014 has been absurd. Performance in geometry was slightly above that in algebra. One of the reasons cited by KNEC (2014) was poor interpretation of the problem, poor teaching strategies showing no innovativeness which does not involve pupils’. In the year 2010 there was an improved performance in algebra where candidates scored a mean score of about 53.05. This showed an improvement on the average scores. This means that teachers might have
involved varied teaching strategies and more practice on algebra. This poor performance from national level is not different from K.C.P.E Mathematics performance in Laikipia West sub-County.

1.2 Statement of the Problem

According to KNEC (2014) the KCPE average performance for algebra question was found to be below the 50% mark and less than the mean score for the other topics. Statistics from KNEC shows that Mathematics, and in particular algebra is among the topics indicated to have been performed poorly by pupils. Poor performance in algebra is largely attributed to learners’ conceptual understanding about the use of the symbols and the context in which it is used. Foster (2007), argues that when learners memorize rules for moving symbols around on paper they may be learning something but they are not learning Mathematics. Moreover, the use of symbols without an understanding cannot develop students’ relational understanding of Algebra. Foster (2007) states that if teachers want students to know Algebra then they must be given a deeper understanding of the use of symbols, through the use of various methods and tools that teacher’s use in teaching algebraic concepts. It is within this background that this study sought to investigate the pedagogic strategies influencing pupils learning of algebraic concepts in the upper primary school classes in Laikipia West sub-County, Laikipia County, Kenya, hence the need for this study.
1.3 Purpose of the Study

The study sought to establish the pedagogic strategies influencing pupils’ learning of algebraic concepts in upper primary school classes in Laikipia west sub-County, Kenya.

1.4 Objectives of the Study

The objectives of the study were

i. To establish the widely used pedagogic strategies in teaching algebra in upper primary classes.

ii. To establish the factors influencing the teachers’ choice of pedagogic strategies in learning of algebra.

iii. To establish the pedagogic strategy that contributes most to pupils learning of algebra in upper primary classes.

1.5 Research Questions

The study intended to answer the following research questions:

i. Which are the most widely used pedagogic strategies applied in the learning and teaching of algebra in upper primary classes?

ii. What are determinants of teacher’s choice of pedagogic strategies in learning of algebra?

iii. What kind of relationship exists between pedagogic strategies and pupils learning of algebra in upper primary classes?
1.6 Significance of the Study

This study will establish the pedagogic strategies influencing pupils learning of algebraic concepts in upper primary schools in Kenya. Varied pedagogic strategies applied in schools may influence the teaching of algebra, and approach to teaching and learning of algebraic concepts. The findings of this study will be useful to primary school Mathematics teachers in applying various teaching approaches. The education sector will also use this information when carrying out monitoring strategies so as to improve teaching of algebra. The KICD will also benefit by involving Mathematics teachers in developing curriculum and make necessary amendments in the syllabus used in schools.

1.7 Assumptions of the Study

The study assumed that all sampled schools use the same syllabus approved by the Ministry of Education Science and Technology, have completed syllabus in preceding classes, have enough resources e.g. textbooks. That all sampled teachers in schools are trained and uses varied teaching strategies while teaching Mathematics.

1.8 Scope of the study

The study was limited to the public and private primary schools in Laikipia West sub-County.
1.8.2 Limitation of the Study

The study was limited to eighty-five (85) primary schools in Laikipia West sub-County (TSC Registry Laikipia West, 2016). Seventeen schools participated in this study, due to the expansive region, if the study was to cover all the schools in the region. Moreover, only trained Mathematics teachers were included in this study because they were trained on teaching methodologies. Further, some schools in the region are situated in remote areas and frequently interrupted by cattle rustlers and this might deter the researcher from accessing some of the schools due to insecurity. Moreover, financial challenges limited the research study to primary schools in Laikipia West sub-County which meant generalization to other sub-Counties in Kenya.

1.9 Theoretical Framework

This study was based on constructivism theory attributed to Jean Piaget (1890-1980). This theory of learning is associated with pedagogic approaches that promote active learning. It is based on the fact that the learner constructs knowledge based on their mental activity and that they always seek meaning as they are active organisms. Based on constructivism theory, active learning and exploration helps students learn better. Instead of the use of textbooks, reciting facts and memorizing, teachers use hands on materials in teaching and encourage the students to explain and think on their reasoning (Dougiamas, 1998). The constructivism theory is based on the central idea that knowledge is not transferrable from one person to another in a ready-made fashion but knowledge has to be constructed by every individual (Von Glassersfeld, 1990). This means that Mathematics
concepts are coherent, they develop in stages. According to Piaget (1973) mathematical knowledge is acquired by students through their internal construction rather than them imposing rules that have been set by teachers. This therefore requires one to create an environment conducive to self-correction.

According to Jaworski (1994), constructivism uses a philosophical approach to learning and knowledge as the theory can be an important tool in the learning of Mathematics compared to other subjects. The National Council on Teachers of Mathematics Standards (NCTM, 1989), the basis of many Mathematics curricula in the USA upholds most of the pedagogical implications of constructivist methodology. As described by Kilpatrick (1978) constructivism consists of two hypotheses;

i) “Knowledge is actively constructed by the cognizing subject not passively received from the environment

ii) Coming to know is an adaptive process that organizes ones’ experiential world, it does not discover an independent, pre-existing world outside the mind of the knower”.

The first and second hypothesis promotes simple models of communication as simple transmission of meaning from one person to another, the prior knowledge of the learner is essential to actively construct new knowledge. Thus, knowledge is not transmitted, rather it is constructed. The initial understanding of knowledge pertains to an individual and it is not a global thing. In addition, prior knowledge has a great impact on the greater learning process.
According to Von Glassersfeld (1990) these two principles view knowledge construction and adaptation as the consequences of cognitive structuring. He further says that knowledge is as a result of individual construction by modification of experiences and that the teacher rather than using a simple straightforward and short route to enable a student to succeed, teachers should use knowledge to encourage students to analyze and also explore the information they come across. Nodding’s (1993) supports the effectiveness of constructivism and imaginatively about the teaching and learning process. From constructivists’ theory if learners are actively involved in teaching and learning, knowledge gained last long in their memory. This theory encourages instructors to base their teaching methods to the responses given by the learners, tailor their teaching strategies to students’ responses and encourage them to analyze and interpret information, learner’s entry behavior is considered so as to encourage them to participate in learning.

1.10 Conceptual Framework
Teaching of Algebraic concepts in schools’ influences learning as it improves learners ‘critical and creative thinking. Pedagogic strategies applied in teaching algebraic concepts may influence primary school learners understanding. The teaching of algebra in primary school may involve applying a number of teaching strategies and use of hands on approaches besides textbooks, provides pupils with concrete modeling experiences. When the teacher has rich algebraic content knowledge, pedagogical content knowledge and applies varied teaching strategies such as (cooperative learning, direct instruction, and problem solving, small group discussion) and considering learner’s entry behaviour he or she may have a motivating lesson delivery and hence promoting better
performance. The conceptual framework will feature both independent and dependent variables.

**Figure 1.2 Conceptual framework**

<table>
<thead>
<tr>
<th>Independent variables</th>
<th>Dependent variable</th>
</tr>
</thead>
<tbody>
<tr>
<td>-Algebraic content</td>
<td>Conceptual understanding of</td>
</tr>
<tr>
<td>-Teacher content</td>
<td>Algebra</td>
</tr>
<tr>
<td>knowledge</td>
<td></td>
</tr>
<tr>
<td>-Pedagogical strategies</td>
<td></td>
</tr>
<tr>
<td>-Pedagogical content</td>
<td></td>
</tr>
<tr>
<td>knowledge</td>
<td></td>
</tr>
<tr>
<td>-Group arrangements</td>
<td></td>
</tr>
<tr>
<td>-Classroom management</td>
<td></td>
</tr>
<tr>
<td>practices</td>
<td></td>
</tr>
</tbody>
</table>

**Intervening variables**

Source: Adopted from Gerlach’s model of systematic approach to teaching (2007)

The independent variable identified include; pedagogic strategies (cooperative learning, direct instruction, problem based learning, problem solving, small group discussion, manipulative models and multiple representations). The researcher will find out how these strategies are applied in teaching and learning of algebra. The dependent variable identified is; understanding algebraic concepts. The conceptual framework will also focus on the intervening variables such as; group arrangement and classroom management practices.
1.11 Operational Definition of Terms

**Algebra:** this is a branch of Mathematics dealing with symbols and the rules for manipulating those symbols.

**Algebraic thinking:** the ability to think about unknown qualities and the relationships between them. It allows students to reason about expressions, functions, equations etc.

**Concepts:** an abstract idea describing some relationship within a group of facts and may be designed by some sign or symbols.

**Teacher Content knowledge:** this is the teacher’s knowledge of the Mathematics he/she is teaching and the organization and the amount of the taught subject matter.

**Cooperative Learning:** An instruction method where the students work together to achieve a laid-out goal.

**Direct Instruction:** this is a teaching method whereby a rationale and direction for learning is laid out where new concepts are related to previous lessons.

**Learner:** a pupil trained and taught by a teacher. Most learners are found in schools where they are registered to the school and treated as students. The learners have to abide by the school rules and laws.

**Representation Techniques:** this is the use of visual media or language to present information and idea in word problems.

**Scaffolding:** this refers to teachers giving support to the learners to enable them succeed and progress in learning Mathematics.
CHAPTER TWO
REVIEW OF RELATED LITERATURE

2.0 Introduction
This chapter serves as the development of the literature review. It discusses the literature from theoretical point of view of various pedagogic strategies for teaching algebra. Further, it reviews literature on how pedagogic strategies influence students learning of algebra and the factors that determine the teacher’s choice of pedagogic strategies in learning algebraic concepts. All this was an effort to highlight the relationship between other studies and this study.

2.1 Typical Pedagogic Strategies in Teaching Algebra

2.1.1 Explicit (Direct) Instruction
According to Swanson (2001), students and their teachers have self-constructed instructions. The teachers give a teaching objective and use a defined instructional sequence. The learners in group and individually look at the curriculum and practice skills using a pace which the teacher determines based on the student’s progress and the teacher knowledge of their needs. Kroesbergen and Van Luit (2003), note that the use of explicit instruction has helped children grasp knowledge when used in a mathematical approach. This instructional process involves appropriately teaching a lesson, giving the students ample time to process and give feedback, encouraging the students to give responses regarding the information, giving and listening, and mentoring the students during the lesson. This motivates the learner as s/he is exposed to the processes of solving mathematical problems. A study by the NMAP (2008) in Australia concluded that the use
of explicit instruction was effective while teaching basic math knowledge or computation compared to teaching of high order Mathematics operations. Direct instruction is a strand-based approach to math instruction that consists of the use of instructional design that is effective, organizing instruction in a logical manner and use of presentation methods that are effective (Stein, M., Silbert, J., and Carnine, D. 1997). Direct instruction may not be favorable to low achievers since not all skills in solving a problem are exhausted. Moreover, quick coverage of the topic may disadvantage slow learners and fail to cope up with fast learners. This study sought to establish how explicit instruction influence learning of algebra.

### 2.1.2 Cooperative Learning

Johnson & Johnson (1999) asserts that cooperative learning is achieved when students work in groups to achieve laid down goals. Further, NCTM supports the use of cooperative learning as it improves Mathematics grades in students with and without learning disabilities (Slavin, 1983). Primary school students through cooperative learning are able to learn more by being actively involved in learning rather than by only watching and listening to the teacher hence enhancing learning in several ways. Involving learners in cooperative learning with the teacher’s guidance and monitoring may help learners achieve and comprehend mathematical concepts. This study was concerned in establishing how cooperative learning is engaged during the teaching of algebra in Mathematics lesson.
2.1.3 Problem-Based Learning

This kind of learning is centered on the student being taught about a subject in terms of complex, realistic and multifaceted problems. Hmelo-Silver, (2004) assert that PBL helps the students to gain skills that are effective in problem solving, acquiring intrinsic motivation, gaining collaboration skills, developing flexible knowledge and acquiring self-directed learning. PBL builds the learners confidence thus enabling them to tackle problems in addition to stretching their knowledge (Barret, 2010).

The students learn through construction of knowledge by use of problems that can be solved in multiple ways (Cotic & Zuljan, 2009). PBL enhances content knowledge: it fosters communication development, learning skills that are self-directed, critical thinking, problem solving and collaboration (Barrett, 2010). In addition, PBL makes use of constructivist learning where the teacher directs and challenges the students during learning rather than providing the needed knowledge alone (Hmelo-Silver & Barrows, 2006). Based on this, reflection and feedback has to be part of learning otherwise effective teaching may not take place as the student would not get the guidance needed to move from theory to practice so as to effectively solve the given problems (Edens, 2000). Therefore, the researcher sought to find out how feedback and solving problems in many different ways influence learning of algebra.
2.1.4 Relations and Visual Representations applications in Mathematics

Some of the representation approaches used in mathematical problems solving are; pictorial (diagramming); mapping instruction (schema-based) and concrete (manipulative) (Xin & Jitendra, 1999). Studies have been done on how visual representations can solve problems based on stories (Walker & Poteet, 2009). They have also been shown to solve basic math problems such as division, multiplication, subtraction and addition methods (Manalo, Bunnell, & Stillman, 2000). Further, they have also been used in comprehending algebra and fractions by students (Butler, Miller, Crehan, Babbitt, & Pierce, 2003). This method provides tools, alternatives and options that are research based to meet up with the instructional knowledge of teaching and learning Mathematics (Gersten, Mundy, Benbow, Clements, Loveless, Williams, Arispe & Banfield, 2008). Arcavi (2008) provide that “understanding the concept of a variable provides the basis for the transition from arithmetic to algebra and is necessary for the meaningful use of all advanced Mathematics.”

Wagner and Kieren (2009) note that, the variable concept is far more complex than teachers’ anticipate and it’s often a barrier to students’ understanding algebra. Some students’ also find it difficult to change their mindset that ‘a’ represents apples to use of ‘a’ in a mnemonic form to stand to a number of apples. Teachers need to carefully explain the use of letter of alphabet in algebra to represent a number so as to have a total representation. Consequently, learners often treat letters like they are symbolic representing some unique numbers. Thus, learners might find it difficult to comprehend how x and y can be both part of an equation such as x+y=4 or how x+y+z can have a
similar meaning to x+p+z (Booth, 1988). Students understanding of variables in algebraic expressions need to be emphasized.

2.1.5 Problem Solving Approach in Mathematics

Problem solving approach in Mathematics and an environment that encourage enquiry from students involves the teacher helping the student have a deeper understanding of mathematical concepts by encouraging them to do Mathematics, create, explore, conjecture, verify and test these concepts (Lester et al, 2004). Word problems can be used in the enhancement and construction of the basic operations meanings (Schifter, 2001). This assists them in understanding of algebra concepts.

Any problem-solving approach seeks to help the students solve problems in a better way so as to improve their performance. Lester, Masingila, Mau Lambdin, Dos Santon & Raymond (2004) emphasized teaching via problem solving rather the teaching on how to solve problems.

Resnick and Klopfer (2009) purport that the use of a problem-solving approach helps to use Mathematics practically, as users of mathematical concepts can think and be adaptable in case of problems such as technology breakdown. This approach can also help people to be more flexible adapting to new work places in today’s era when workers are faced by career changes in their employment lifetime (NCTM, 2009).

Cockcroft (2002) encouraged the use of problem solving approach so as to develop more critical thinking in Mathematics and in daily life. He also states that through this, problem solving is at the heart of Mathematics since it can be used in different familiar instances.
The researcher had sought to find out how Mathematics teachers use problem solving approach by involving pupils in constructing mathematical ideas and solving algebraic problems in class.

### 2.1.6 Small Group Discussion

Good and Biddle (1988) argue that small group instruction is not a panacea but an attractive instructional format that, when properly implemented (for example, careful organization, appropriate tasks) could enable teachers to achieve certain goals. Johnson, Johnson & Maruyame (1983) asserts that, instructions on small teams are in essence motivational concepts, and they help learners in the groups to master mathematical concepts and skills. Without motivational practices during classroom discussion, mastery of skills and concepts may be futile. According to Lindquist (1989) the use of small groups for Mathematics instruction and learning can encourage students’ verbalization increase students responsibility for their own learning; encourage pupils to work cooperatively in ways that build social skills; lead to variety to mathematical classes routines, allow the teachers to instruct the learners individually and accommodate their students’ abilities, interests and needs and improve the students ability to solve some problems by different means. The researcher sought to find out how Mathematics teacher involves pupils in small group discussions, in solving mathematical problems.
2.2 Teachers’ Choice of Pedagogic Strategies in Teaching Algebra

2.2.1 Teacher Content Knowledge

Having deep understanding in algebra as a teacher is the most important aspect in teaching of the subject (Ball & Bass, 2000). Mathematics’ teachers’ in the school should share ideas and form discussion forums through which they can share knowledge amongst one another (Kazemi, 2008).

Research by Hiebert and Grouws (2007) reveals that better pupils’ intake of knowledge depends on a wide range of factors. Therefore, it is very important that teachers develop high understanding of Mathematics concepts in order to increase the rate at which pupils are able to grasp what is being taught. Good classroom organization, and teacher’s mastery of content enhances Mathematics learning. Engaging subject panels in schools helps the teachers in preparing teaching resources, and being innovative using locally available materials. The researcher sought to establish the involvement of school administration, subject panels and education sector cooperates with Mathematics teachers in enhancing teaching of Mathematics in a classroom situation. It is very important for the teacher to come up with an outlined plan on how to help students understand basic algebraic concepts in Mathematics. This is done bearing in mind that different approaches have to be used for different students (Hill, Rowan, & Bass, 2005). Further, the whole school fraternity has to come up with ideas which will enhance their teachers’ knowledge in Mathematics as well as improving their skills when it comes to teaching Mathematics (Cobb & McClain, 2001). Mathematics panels work hand in hand in enhancing learning of Mathematics and analyzing pupils’ performance. Conceptualization of teaching systems relies more on how well the students are able to
grasp the mathematical concepts and not necessarily how best the teaching was administered (Tower & Davis, 2002).

2.2.2 Teachers Pedagogical Content Knowledge

According to Shulman (2006), pedagogical content knowledge encompasses:

“the ways of representing and formulating the subject that makes it comprehensible to others... an understanding of what makes the learning of specific topics easy or difficult: the conceptions and preconceptions that students of different ages and backgrounds bring with them to the learning of those most frequently taught topics and lesson” (p. 9)

Teachers with a wide understanding of the subject they teach will use their knowledge to come up with solutions to problems that might arise during the teaching process. Teachers who have little understanding on the subject they teach tend to lean much on what is outlined in the syllabus, instead of forming ideas through which pupils can better understand and enjoy learning. A teacher who has a deep understanding of the class is able to come up with defined methods under which to increase understanding and knowledge intake among the pupils (Askew, et al., 1997; Hill & Ball, 2005). Knowledgeable teachers teach content from known to unknown considering the pupils’ level of understanding. They engage students in solving or working out more problems in all approaches that learner may understand with ease. The researcher sought to establish the teacher’s pedagogical content knowledge in teaching algebraic concepts while teaching Mathematics in standard seven classes.
2.2.3 Learners Entry Behavior in algebra

Entry behavior is the maximum knowledge that a student has in regard to a particular subject. It basically represents the basic understanding the students has been able to grasp through previous sessions of learning (Tomlinson & Eidson, 2003). Considering their entry behavior, pupils may overcome many conceptual obstacles. Therefore, it is important that the teacher understands the difficulties that each student is facing judging from the entry behavior. With such information, the teacher can then work out the best methods through which each student will be able to overcome the learning challenges (Kapusnick & Hauslein, 2001). The researcher sought to examine the learner’s algebraic entry behavior in learning that help students to develop conceptual understanding of algebra.

2.3 Pedagogic Strategies and Learning of Algebra

2.3.1 Solving Algebraic Equations

A linear algebraic equation is one of the topics which pupils have a problem in understanding (National Mathematics Advisory Panel, 2008). The fact that algebraic equations are expressed more in symbols rather than material concepts presents a big challenge for the pupils since they cannot relate the problem being solved (Yeap, 2009, p 32).

The basic procedures which are applied by the teachers in solving algebraic problems such as using words like “cancel” presents an even higher challenge to the pupils as they try to understand the basic concepts (Martinez, 1988). Use of such words may be
challenging to learners. The researcher sought to find out the widely used pedagogic strategy that Mathematics teachers apply in solving algebraic concepts.

**2.3.2 Group arrangements**

According to research, when small-group is arranged correctly students are able device ways under which to solve complex mathematical problems (O’Connor & Michaels, 1996). The teacher will, therefore, be required to come up with clear guidelines to follow when doing group arrangement to ensure that students do not abuse the personal time given to them and most important that each student is actively able to participate in the discussions (Hunter, 2008). This encourages pupils to think critically. Group arrangement also help a lot in widening the capacity thinking of individuals, this is more because group members are able to challenge one another intellectually, thus increasing personal scope of thinking. (Ding, Li, Piccolo, & Kulm, 2007).

Further, knowing the level at which each student is, in terms of knowledge understanding helps the teachers to set out personal questions and arithmetic problems for each student. The content delivered should be coherent, that is, related to one another. According to Houssart (2002), for those students who have a problem in understanding the basic concepts in arithmetic, the teacher must use his/her understanding in that particular topic to make sure that those particular students are brought at par with the rest of the class, without dwelling too much on one problem or reducing the student interest to that topic. The researcher was interested in finding out how teachers organize partner arrangements in enhancing learning and how teaching is carried out considering learner’s ability level.
2.3.3 Mathematical Communication and Algebra

Mathematics being a subject that normally deals with symbols and numbers has different communication channels all which are acceptable. These include symbols, graphs, and diagrams among others (Shield & Galbraith, 1998). A teacher will be required to have good communication skills in order to create a productive dialogue when tackling Mathematical problems (Walshaw & Anthony, 2008). According to National Council of Teachers of Mathematics, it is important that student learn how to express their mathematical solutions verbally and not just through symbols. Reasoning is more enhanced when students are able to express their mathematical solutions verbally (NCTM, 1989). Interpretation of a mathematical problem by learners in their first language (mother tongue) is important as it enhances understanding. Lampert (1991) emphasizes that a student must be able interpret the meaning of mathematical symbols through words since this will allow the teacher to assess the student level of understanding in regard to those symbols. For the student to develop mathematical communication skills there must be dialogue between the learner and the teacher who will be able to offer more insight to the meaning of mathematical symbols (Bishop, 1985). The researcher sought to establish how the mathematical language developed by pupils using mathematical symbols in communicating algebra enhances learning and understanding of algebraic concepts.

2.3.4 Classroom Management Practices

In a successful classroom management, the teacher must be able to come up with a healthy atmosphere in class which allows for smooth learning both in academics and also
behavior learning (Evertson & Weinstein 2006). The teacher must, therefore, outline steps which will ensure that students are not participating in unruly behavior which might delay or diminish successful academic learning (Evertson, Emmer, Sanford & Clement, 1983). When classroom management is well established it allows for smooth learning where students can comfortably focus on academic learning without any outside interference (Lewis & Sugai, 1999). Rules and regulation are key components in establishment of successful classroom management. They provide an outline of what is expected from students and what happens if those rules are followed (Colvin, Kame’enui, & Sugai, G., 1993). With such guidelines, inappropriate behaviors can be easily managed. The teacher is also in a good position to note students who engage in unhealthy behavior and take actions to prevent such behaviors from getting out of hand (Colvin et al., 1993). According to Carolyn and Carol (2006) a teacher needs to create a healthy and non-strained relationship with the students to ensure that there is proper communication. He can also come with friendly but successful actions to encourage unruly students to change their behaviors. The researcher sought to establish how Mathematics teacher enhance classroom control during teaching of algebra.

2.4 Summary in Literature
The literature related to teaching approaches of classroom discourse indicates that teachers who specialize in Mathematics should have a proper understanding of algebra so that they will be able to translate their knowledge of algebra into effective teaching of algebra to pupils. They must be able to think outside the box and come up with unique ways of presenting and explaining the acquired knowledge of algebra to their pupils. It’s
noted that with regard to teaching for understanding algebra by mere telling will not result in the kind of understanding required of the curriculum.

Varied methods of teaching supported by the KICD in the new primary school syllabus (2002) have led to a lot of improvement in Mathematics learning by pupils with special needs and the normal students as well. Students who develop mathematical language improve their reasoning hence enhancing interpretation of mathematical problems. Also, communication involving both Mathematics teacher and students improves. In Kenyan school, Mathematics curriculum teaching of algebra includes use of letters for numbers, simplification of algebraic expressions, finding the values of unknown quantities and use of equality and inequality in symbols. The researcher sought to establish the impact of pedagogic strategies, teachers’ content knowledge, and learner’s entry behavior, and algebraic mathematical language, applied in teaching Mathematics influence the pupils learning of algebraic concepts in upper primary school classes in Laikipia West sub-County.

From the empirical studies reviewed, it has been shown that students’ interpretation of symbols in algebra is not proper because some of the difficulties faced by the students are specific to algebraic expressions (Kuchemann, 1981 & Clement, 1982). For instance, a difficulty in algebraic understanding of expression was identified by Davis (1985). He called the "name-process" dilemma by which an expression such as 6x is interpreted in algebra as an indication of a process "What you get when you multiply 6 by x" and a "name for the answer". Brizuela & Schliemann (2006) have suggested that the term
"process-product dilemma" better describes this problem. Collis theory of the student's Acceptance of the Lack of Closure (ALC) is a little bit different in describing the level of closure at which the pupil is able to work with operations (Collis, 1975). He observed that at the age of seven, children require that two elements connected by an operation (e.g. 3 + 2) be actually replaced by a third element; from the age of 10 onwards, they do not find it necessary to make the actual replacement and can also use two operations (e.g. 6+4 +5); twelve year-olds can refrain from actual closure and are capable of working with formulas such as Volume = L x B x H; between the ages of 13 - 15, although students are not yet able to handle variables, they have no difficulty with symbolization as long as the concept symbolized is underpinned by a particular concrete generalization. Collis' ALC theory is particularly relevant to the teaching of algebraic expressions since the operations performed on the pro-numerals cannot be closed as in arithmetic. For example, in the response to a question in a research most of the students could not accept $8 \times a$ as the area of an indicated rectangle unless it was inserted in the formula "Area of rectangle = $8 \times a$".

Empirical studies reviewed have failed to establish the pedagogic strategies used in teaching algebra and how these pedagogic strategies influence pupils learning of algebraic concepts. It is against this backdrop in research that the study sought to fill the existing research gap by conducting a study to investigate the pedagogic strategies influencing pupils learning of algebraic concepts in the upper primary school classes in Kenya.
CHAPTER THREE
RESEARCH DESIGN AND METHODOLOGY

3.1 Introduction
The following study establishes the pedagogic strategies influencing pupils learning of algebraic concepts in upper primary schools in Laikipia County. This chapter covers the following sub-sections: the research design, the study variables, location of the study, target population, sampling technique, sample size, research instrument, pilot study, data collection and data analysis.

3.2 Research Design and Locale

3.2.1 Research Design
The main aim for carrying out this study was to establish pedagogic strategies influencing pupils learning of algebraic concepts in upper primary schools’ classes in Laikipia County. A descriptive survey was used during this investigation. Survey design was adopted to gather data and compare different variables while also determining the common factor among events that have been adopted for the study (Orodho, 2003).

Survey method was commonly used to establish the pedagogic strategies influencing pupils learning of algebraic concepts in upper primary school classes in Laikipia West sub-County. The adopted design was very essential in coming up with remedy once the root of the problem was identified. Moreover, exploratory and quantitative researches were adopted in this study. Quantitative research is especially useful since it enables the researcher to gather different views for one particular question from many respondents. It
employs methods such as interview and observation schedule (Orodho, 2003). Carrying out interviews, asking questions and doing close observation of respondents were the methods used to gather information for this study.

In research, variables are either dependent or independent, hence for this survey. Independent variables are; teaching methods while the dependent variable include; algebraic concept. Intervening variables are; teacher pedagogical content knowledge, learner’s entry behavior, and pedagogical content knowledge.

3.2.2 Location of the Study
This survey covered Laikipia West sub-County in Laikipia County, Kenya. The County was considered due to its poor performance in Mathematics.

3.3 Sample Population
The target population was 85 primary schools in Laikipia West sub-County. The total population in the targeted learning institutions was 8016 pupils and 581 teachers (TSC Registry Laikipia West sub-County 2016). The researcher targeted 34 Mathematics teachers teaching Mathematics and 260 pupils in standard seven classes.
Table 3.1: Allocation of institutions and tutors per Division

<table>
<thead>
<tr>
<th>Division</th>
<th>Number of primary schools</th>
<th>% of the total number of schools</th>
<th>Number of Teachers</th>
<th>% of the total number of Teachers</th>
<th>Number of pupils in upper primary</th>
<th>% of the total number of pupils</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rumuruti</td>
<td>29</td>
<td>34.11</td>
<td>215</td>
<td>37.0</td>
<td>3361</td>
<td>41.9</td>
</tr>
<tr>
<td>Muhotetu</td>
<td>19</td>
<td>22.35</td>
<td>124</td>
<td>21.34</td>
<td>1605</td>
<td>20.0</td>
</tr>
<tr>
<td>Ol’moran</td>
<td>19</td>
<td>22.35</td>
<td>107</td>
<td>18.41</td>
<td>1204</td>
<td>15.0</td>
</tr>
<tr>
<td>Sipili</td>
<td>18</td>
<td>21.17</td>
<td>135</td>
<td>23.23</td>
<td>1846</td>
<td>23.1</td>
</tr>
<tr>
<td>Total</td>
<td>85</td>
<td>100</td>
<td>581</td>
<td>100</td>
<td>8016</td>
<td>100</td>
</tr>
</tbody>
</table>

Source: TSC Registry, Laikipia West District (2016)

3.4 Sampling Technique and Sample Size Determination

3.4.1 Sampling Technique
The researcher used random sampling to sample the county. Random sampling was used to select 17 primary schools from the four divisions in the sub-County. This represented 20% of the target population to ensure all categories in the population were represented.

According to Mugenda and Mugenda (1999), a sample between 10 to 50% is representative. Further, random sampling was used in selecting two hundred and sixty class seven pupils following the class register. Their admission numbers were written on papers and put in a closed box. Kothari (2004) advocates for unsystematic sampling since it best represent the true figure of a group especially when done on average. This allowed every pupil a chance of being selected as a respondent.

3.4.2 Sample Size Determination
Two of the schools were used for piloting purposes. Simple unsystematic sampling was applied to pick two Mathematics teachers per a sampled school. 20% of all the schools were randomly sampled from the four divisions to give a good representative sample for
this study. This resulted to seventeen schools (17) in the sub-County. Standard seven class purposively selected from public primary schools were considered for this study because they had covered syllabus and were better placed to answer KCPE questions.

3.5 Research Instruments
The tools to be used for this study included questionnaires for the teachers and students, and teacher’s observation and interview schedule guide. Questionnaires were used because it’s more efficient as it requires less time and allows for the collection of data from a larger sample (Orodho, 2003).

3.5.1 Questionnaires for Teachers
The teachers question sheet had questions that required a definite yes or no answer and those which required a detailed answer. This enabled the researcher get information on teaching strategies, instructional practices for algebra, classroom assessment techniques, planning, preparation and feedback. The closed ended questionnaires required the respondents to provide facts on matters pertaining to pedagogic strategies. On the other hand, open ended questionnaires allowed teachers to express their views about the teaching of algebra.

3.5.2 Questionnaires for Pupils
Pupil’s questionnaires helped to elicit general information on teaching of algebra in schools. It contained questions on achievement tests in algebra.
3.6 Reliability and Validity determination

3.6.1 Reliability

A research instrument is considered reliable when it consistently generates the same results when the units being measured hasn’t changed (Sekaran & Bougie, 2010). The study adopted internal consistency procedure, through which the researcher used Cronbach Alpha to check the reliability of instruments to be used in the study. To check reliability of the research instruments, the researcher conducted a pilot study on 28 respondents both pupils and teachers from the target population. The results of the pilot study were discussed with experts and supervisors to come to a conclusion on the reliability of the research instruments. Alpha values range from 0 to 1 and a co-efficient of 0.7 is acceptable with 0.8 and or higher indicating good reliability of the instruments (Delafrooz, et al., 2009). Those who participated in pilot phase were not included in the actual study. The study established a Cronbach Alpha of 0.813, which is an indication of good reliability of the instruments as recommended by Delafrooz, et al., (2009).

Reliability is used to describe the extent at which a test can be consistent and reliable. When a test is reliable, it means that values derived from two or three samples can show a general trend towards expected results (Orodho, 2003). Major variables that were used in the study on pedagogic strategies influencing teaching of algebra are; teacher pedagogical content knowledge, textbook availability, teaching styles, entry behavior and class size. The researcher used Cronbach’s alpha (1982) formula to measure the internal consistency reliabilities.
\[ \alpha = \frac{K}{K-1} \left[ 1 - \frac{\sum S^2_i}{S^2_X} \right] \]

Where K: the number of items on the test
\( \alpha^2 \): the variance of item  \( \alpha^2X \): the total test variance

### 3.6.2 Validity

According to Leedy & Ormrod (2005), the validity of a research instrument refers to the degree to which the instrument measures what it is expected to measure. This is echoed by Saunders et al., (2009) who emphasize that validity is achieved when a research instrument measures what it is intended to measure. The researcher looked into content validity of the research instruments through constant consultations with experts and supervisors. This helped the researcher in establishing whether the chosen measurement tools include a sufficient and indicative set of items to cover the concept under study. Consultations also assisted the researcher in making modifications to the structure of research tools as advised by experts.

### 3.7 Data Collection

#### 3.7.1 Logical and Ethical Consideration

Consent was sought from intended research participants to indicate their willingness to participate; the researcher also ensured anonymity when it comes to answering the questions in the study questionnaire. The researcher ensured that the information was used for research purposes only. The researcher also acknowledged secondary data from all the sources of literature collected for the purpose of this study in the reference list. In
complying with University Standards, the researcher availed the final research report to
the technical institutions’ management and education officers in the study locale that
expressed interest in reading it, and also availed it at the Kenyatta University library.

3.7.2 Research Protocol and Itinerary
To conduct this study, the researcher sought a permit from the National Commission for
Science, Technology and Innovation (NACOSTI). The researcher sought permission
from the County director of education to conduct the study in schools within the county.

3.7.3 Actual data Collection
Before the actual administrations of the research instruments, schools were notified
through their authority, the question sheets for each respondent were also handed out
during this time. Questionnaires were distributed to 34 Mathematics teachers and 260
class seven pupils in the sub-County, simultaneously in each institution where survey was
being carried out. Interviews were done and an observation schedule administered in
each school in the sample.

3.8 Data Analysis
Data analysis is the process of evaluating data to come with meaningful information
which is relevant to the study being carried out (Mugenda & Mugenda, 1999). Exploratory research for this survey was obtained from detailed and direct type of
questions, carrying out observations and also conducting interviews. Data was collected,
analyzed qualitatively and quantitatively using Statistical Package for Social Sciences
(SPSS version 22.0). Descriptive Recounting statistics were applied in the scrutinizing of
information collected. Analyzed data was presented in the form of frequency table, bar graphs and pie charts based on the objectives. On the first objective, simple descriptive statistics, mean, was used to establish the widely used pedagogic strategies in teaching algebra in upper primary classes. In the second objective, the factors influencing the teachers’ choice of pedagogic strategies in learning of algebra were captured verbatim through observation and by use of chi-square test. Analysis of variance (ANOVA) was used to establish the widely used pedagogic strategies in teaching algebra in upper primary classes.
CHAPTER FOUR
DATA ANALYSIS, INTERPRETATION, PRESENTATION AND DISCUSSION

4.1 Introduction
This chapter covers data analysis, explanation, discussion and presentation of results gathered from the survey. Detailed information about each respondent used in this study has also been provided. The results of the survey have been analyzed using illustrative and inferential statistics. The number of respondents was 34 Mathematics teachers and 260 students from which 25 teachers and 186 students successfully participated in the survey. This represented 71.7 percent of the total respondents. This number was good enough to derive a constructive conclusion of the survey. According to Mugenda and Mugenda (1999), any figure above 70% is considered an excellent response rate hence the same conclusion was considered for this study.

4.1.1 Response Rate
Table 4.1: Response rate for pupils and teachers

<table>
<thead>
<tr>
<th>Questionnaire</th>
<th>Target</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Filled and Returned</td>
<td>294</td>
<td>211</td>
<td>71.7</td>
</tr>
</tbody>
</table>

4.2 General Information of the teachers
In this survey, demographic information of the teachers was captured. Respondents were requested to indicate their gender, age, highest level of education, length of service, the class they teach Mathematics and the duration of time when they have been in teaching service.
4.2.1 Gender of the Teachers
The teachers sampled were asked to indicate their sex.

Figure 4.1: Gender of the Respondents

As per the study results, most teachers turned out to be males as shown by 64% whereas 36% of the teachers indicated that they were female. These findings show that majority of the Mathematics teachers at the level at which the study focused on were male.

4.2.2 Age of the Teachers
The study sought to determine the age of the Mathematics teachers.

Figure 4.2: Age of the Teachers
From the survey, majority of the teachers were aged between 34 to 41 years as shown by 44%, the age of 16% was 42 to 49 years, 32% of the teachers ranged from 26 to 33 years and 8% of the teachers were 50 years going up. From figure 4.2 it is evident that Mathematics teachers are distributed in all the age categories.

### 4.2.3 Highest Level of Education

The teachers were requested to indicate their highest level of education.

**Figure 4.3: Highest Level of Education of the teachers**

<table>
<thead>
<tr>
<th>Highest Level of Education</th>
<th>% Respondents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Postgraduate Degree</td>
<td>16</td>
</tr>
<tr>
<td>Bachelors Degree</td>
<td>72</td>
</tr>
<tr>
<td>Diploma</td>
<td>12</td>
</tr>
</tbody>
</table>

From findings in the survey, majority of teachers had a Bachelor’s degree as shown by 72%, 16% of the teachers. 16.0% of the teachers had postgraduate degree while 12% had a diploma. These findings depict that Mathematics teachers were well educated to understand the questions and thus would give credible information related to this study.
4.2.4 Number of years the teachers had served

Figure 4.4: Teachers years of service

In their teaching service, the study revealed that most of the respondents as shown by 44% had served the organization for more than 6 years, 30% of the respondents had served for a period of 4 to 6 years. 18% of the respondents had served the organization for a period of 2 to 4 years whereas 8% of the respondents had served the organization for not more than 2 years. This is an indication that the teachers gave credible information related to the study since they fully understand the Mathematics syllabus. The teachers further indicated that they are trained and that they teach Mathematics in standard 7 and 8.

4.2.5 Mathematics Lessons

The study sought to determine the number of Mathematics lessons the teachers are allocated in each week. The teachers indicated that they are allocated seven Mathematics lessons in a week. This is because Mathematics is taught in every day of the week. Standard seven classes had an average number of 45 students and the ratio of Mathematics pupil to textbook in their classes was 1:4.
4.3 To establish the widely used pedagogic strategies in teaching algebra in upper primary classes.

4.3.1 Teachers Choice of Teaching Strategies

The teachers were requested to rate the frequency of the following teaching strategies in relation to learning of algebra in class.

Table 4.2: Teachers Choice of Teaching Strategies

<table>
<thead>
<tr>
<th>Teaching Strategy</th>
<th>Most Frequent</th>
<th>Least Frequent</th>
<th>Not Applied</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cooperative Learning</td>
<td>15 (60.0%)</td>
<td>9 (36.0%)</td>
<td>1 (4.0%)</td>
<td>1.440</td>
</tr>
<tr>
<td>Problem Based Learning</td>
<td>4 (16.0%)</td>
<td>18 (72.0%)</td>
<td>3 (12.0%)</td>
<td>1.960</td>
</tr>
<tr>
<td>Direct Instruction</td>
<td>13 (52.0%)</td>
<td>10 (40.0%)</td>
<td>2 (8.0%)</td>
<td>1.560</td>
</tr>
<tr>
<td>Problem Solving</td>
<td>16 (64.0%)</td>
<td>6 (24.0%)</td>
<td>3 (12.0%)</td>
<td>1.480</td>
</tr>
</tbody>
</table>

The study findings revealed that Cooperative Learning strategy and Problem Solving strategies were most frequently used by Mathematics teachers as shown by a mean of 1.440 and 1.480 respectively. Problem Based Learning strategy and Direct Instruction strategy were least used by Mathematics teachers as shown by a mean of 1.960 and 1.560 respectively. These findings show that the four teaching strategies were being used by Mathematics teachers in teaching Mathematics, with the Cooperative Learning being the most frequently used (60.0%). The findings were found to concur with the findings of Slavin (1983) who argued that, NCTM does support learning through cooperative method as it helps students with and without disability improve their mathematical understanding. This is because through cooperative learning, the students can learn much more since they are actively involved in learning rather than learning through the traditional means of listening and watching.
4.3.2 An Investigation of Instructional Practices for Algebra

The teachers were requested to indicate their opinion with the provided statements relating to teaching strategies.

**Table 4.3: Cooperative Learning**

<table>
<thead>
<tr>
<th>Cooperative Learning</th>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Moderate</th>
<th>Agree</th>
<th>Strongly Agree</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>I collaborate with the whole class when seeking a solution for the problem at hand.</td>
<td>0 (0.0%)</td>
<td>0 (0.0%)</td>
<td>3 (12.0%)</td>
<td>19 (76.0%)</td>
<td>3 (12.0%)</td>
<td>4.00</td>
</tr>
<tr>
<td>I allow pupils to be involved in cooperative problem solving.</td>
<td>0 (0.0%)</td>
<td>1 (4.0%)</td>
<td>4 (16.0%)</td>
<td>16 (64.0%)</td>
<td>4 (16.0%)</td>
<td>3.92</td>
</tr>
<tr>
<td>I allow pupils to discuss solutions to algebra problems with peers.</td>
<td>1 (4.0%)</td>
<td>1 (4.0%)</td>
<td>6 (24.0%)</td>
<td>15 (60.0%)</td>
<td>2 (8.0%)</td>
<td>3.64</td>
</tr>
<tr>
<td>I don’t pair pupils to work as peer tutors</td>
<td>1 (4.0%)</td>
<td>0 (0.0%)</td>
<td>3 (12.0%)</td>
<td>20 (80.0%)</td>
<td>1 (4.0%)</td>
<td>3.80</td>
</tr>
<tr>
<td>I reward group performance in the cooperative setting.</td>
<td>0 (0.0%)</td>
<td>3 (12.0%)</td>
<td>2 (8.0%)</td>
<td>18 (72.0%)</td>
<td>2 (8.0%)</td>
<td>3.76</td>
</tr>
<tr>
<td>I assign pupils to work in homogeneous groups</td>
<td>1 (4.0%)</td>
<td>0 (0.0%)</td>
<td>3 (12.0%)</td>
<td>19 (76.0%)</td>
<td>2 (8.0%)</td>
<td>3.84</td>
</tr>
<tr>
<td>I assign pupils to work in heterogeneous groups.</td>
<td>0 (0.0%)</td>
<td>1 (4.0%)</td>
<td>2 (8.0%)</td>
<td>17 (68.0%)</td>
<td>5 (20.0%)</td>
<td>4.04</td>
</tr>
<tr>
<td><strong>Overall mean</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td><strong>3.86</strong></td>
</tr>
</tbody>
</table>

From the study findings, majority of the teachers agreed (88.0%) that they: assign pupils to work in heterogeneous groups, as shown by a mean of 4.040; 88.0% of the teachers work together with the entire class when looking for a solution to a given problem, as shown by a mean of 4.000; 80.0% of them allow pupils to engage in cooperative problem solving, as shown by a mean of 3.920; 84.0% assign pupils to work in homogeneous groups, as shown by a mean of 3.840; 84.0% agreed don’t pair pupils to work as peer tutors, as shown by a mean of 3.800; 80.0% agreed that they reward group performance in the cooperative setting, as shown by a mean of 3.760; and 68.0% of the teachers
agreed that they allow pupils to hold discussions with peers on algebraic solution on algebraic problems, as shown by a mean of 3.640. These findings show that the Mathematics teachers have emphasized the use of cooperative learning strategy in teaching Mathematics in their school. These findings concur with those of Slavin (1983) who asserts that involving learners in cooperative learning with the teacher’s guidance and monitoring may help learners achieve and comprehend mathematical concepts.

4.3.3 Problem-based Learning

Table 4.4: Problem-based Learning

<table>
<thead>
<tr>
<th>Statements</th>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Moderate</th>
<th>Agree</th>
<th>Strongly Agree</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>I have pupils’ come up with their own rules when solving new problems.</td>
<td>12 (48.0%)</td>
<td>10 (40.0%)</td>
<td>3 (12.0%)</td>
<td>0 (0.0%)</td>
<td>0 (0.0%)</td>
<td>1.640</td>
</tr>
<tr>
<td>I draw mathematical concepts from &quot;real-life&quot; situations.</td>
<td>10 (40.0%)</td>
<td>10 (40.0%)</td>
<td>4 (16.0%)</td>
<td>1 (4.0%)</td>
<td>0 (0.0%)</td>
<td>1.840</td>
</tr>
<tr>
<td>I have students pursue projects that are open-ended and those that need extended problem solving skills.</td>
<td>11 (44.0%)</td>
<td>9 (36.0%)</td>
<td>5 (20.0%)</td>
<td>0 (0.0%)</td>
<td>0 (0.0%)</td>
<td>1.760</td>
</tr>
<tr>
<td>I come up with problems that are in line with individual student’s interests.</td>
<td>12 (48.0%)</td>
<td>7 (28.0%)</td>
<td>4 (16.0%)</td>
<td>1 (4.0%)</td>
<td>1 (4.0%)</td>
<td>1.880</td>
</tr>
<tr>
<td>I don’t use practices that require problem-solving skills.</td>
<td>12 (48.0%)</td>
<td>8 (32.0%)</td>
<td>2 (8.0%)</td>
<td>1 (4.0%)</td>
<td>2 (8.0%)</td>
<td>1.920</td>
</tr>
<tr>
<td>I put more emphasis on the process of problem-solving than on the solution.</td>
<td>9 (36.0%)</td>
<td>13 (52.0%)</td>
<td>2 (8.0%)</td>
<td>1 (4.0%)</td>
<td>0 (0.0%)</td>
<td>1.800</td>
</tr>
<tr>
<td><strong>Overall mean</strong></td>
<td><strong>1.81</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The study sought to determine the level at which teachers agreed with the statements relating to problem-based learning. The results findings showed that majority of the teachers (48.0%) strongly disagreed that they; have pupils come up with their rules when
faced with new problem solving situations, as shown by a mean of 1.640; 44.0% strongly agreed that they have pupils use open-ended and extended problem solving projects, as shown by a mean of 1.760; 88.0% agreed that they put more emphasis on the problem solving process than on the solution, as shown by a mean of 1.800; 80.0% of the teachers did not draw mathematical concepts from "real-life" situations, as shown by a mean of 1.840; and that 76.0% did not create problems from the interests of individual pupils, as shown by a mean of 1.880. These findings show the level at which Mathematics teachers have embraced the problem-based learning strategy, this is because problem-based learning enhances content knowledge, fosters communication development, critical thinking, skills in self-directing, collaboration skills and problem solving skills (Barrett, 2010).
4.3.4 Direct Instruction strategy

Table 4.5: Teachers' opinion on direct Instruction strategy

<table>
<thead>
<tr>
<th>Direct Instruction</th>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Moderate</th>
<th>Agree</th>
<th>Strongly Agree</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>I use examples that are already pre-worked to reinforce or introduce my topics.</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>17</td>
<td>4</td>
<td>3.880</td>
</tr>
<tr>
<td>(4.0%)</td>
<td>(4.0%)</td>
<td>(8.0%)</td>
<td>(68.0%)</td>
<td>(16.0%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I close instruction by putting more emphasis on previously covered work and reviewing concepts when giving feedback, I focus on error patterns and incorrect responses.</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>14</td>
<td>5</td>
<td>3.709</td>
</tr>
<tr>
<td>(8.0%)</td>
<td>(4.0%)</td>
<td>(12.0%)</td>
<td>(56.0%)</td>
<td>(20.0%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I use a new concept or skill after identifying at the start of instruction and give a rationale for teaching it.</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>19</td>
<td>4</td>
<td>4.080</td>
</tr>
<tr>
<td>(0.0%)</td>
<td>(0.0%)</td>
<td>(8.0%)</td>
<td>(76.0%)</td>
<td>(16.0%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I give instruction in sequence, moving the students from concrete concepts to abstract concepts in well-defined steps.</td>
<td>3</td>
<td>1</td>
<td>4</td>
<td>13</td>
<td>4</td>
<td>3.560</td>
</tr>
<tr>
<td>(12.0%)</td>
<td>(4.0%)</td>
<td>(16.0%)</td>
<td>(52.0%)</td>
<td>(16.0%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I encourage students to provide a one-step-at-a-time process when working equations.</td>
<td>0</td>
<td>2</td>
<td>3</td>
<td>18</td>
<td>2</td>
<td>3.800</td>
</tr>
<tr>
<td>(0.0%)</td>
<td>(8.0%)</td>
<td>(12.0%)</td>
<td>(72.0%)</td>
<td>(8.0%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I do not provide graded homework for feedback purposes.</td>
<td>3</td>
<td>0</td>
<td>4</td>
<td>15</td>
<td>3</td>
<td>3.600</td>
</tr>
<tr>
<td>(12.0%)</td>
<td>(0.0%)</td>
<td>(16.0%)</td>
<td>(60.0%)</td>
<td>(12.0%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>When giving practice work, I make sure that most of the problems given are reviewed in previous lessons.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>17</td>
<td>2</td>
<td>3.680</td>
</tr>
<tr>
<td>(4.0%)</td>
<td>(8.0%)</td>
<td>(12.0%)</td>
<td>(68.0%)</td>
<td>(8.0%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Overall mean</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td><strong>3.76</strong></td>
</tr>
</tbody>
</table>

The study findings established that majority of the teachers, 94.0% agreed that they: target incorrect responses and error patterns when providing feedback, as shown by a mean of 4.080; 84.0% use examples that are already pre-worked to reinforce or introduce their topics, as shown by a mean of 3.880; 80.0% encourage pupils to show a one-step-at-a-time process in giving worked equations, as shown by a mean of 3.800; 80.0% agreed that they provide an instruction sequence moving the students from concrete concepts to
abstract concepts in well-defined steps, as shown by a mean of 3.760; 76.0% do a close up of instruction giving by providing a review of the concepts and putting more emphasis on concepts that had been previously covered, as shown by a mean of 3.709; 76.0% agreed that they make sure that most of given practice work, are previously reviewed questions when assigning practice work, as shown by a mean of 3.680; 72.0% stated that they do not provide graded homework to provide feedback, as shown by a mean of 3.600; and 68.0% come up with a new skill or concept at the start of instruction giving and give a reason for teaching it, as shown by a mean of 3.560. These findings depict that Mathematics teachers have embraced use of direct Instruction strategy to teach Mathematics in the schools. The findings are in line with the literature by NMAP (2008) that the use of direct instruction was more efficient when used for basic math learning or computation purposes than for teaching high math order.
4.3.5 Manipulative, Models, and Multiple Representations

Table 4.6: Manipulative, Models, and Multiple Representations

<table>
<thead>
<tr>
<th>Manipulative, Models, and Multiple Representations</th>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Moderate</th>
<th>Agree</th>
<th>Strongly Agree</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>I encourage pupils to use cubes, beam balance or blocks to represent algebraic equations.</td>
<td>10 (40.0%)</td>
<td>9 (36.0%)</td>
<td>3 (12.0%)</td>
<td>2 (8.0%)</td>
<td>1 (4.0%)</td>
<td>2.000</td>
</tr>
<tr>
<td>I teach students to use graphs for representing algebraic equations.</td>
<td>9 (36.0%)</td>
<td>11 (44.0%)</td>
<td>3 (12.0%)</td>
<td>2 (8.0%)</td>
<td>0 (0.0%)</td>
<td>1.920</td>
</tr>
<tr>
<td>I teach students to use tables to represent the algebraic equations.</td>
<td>12 (48.0%)</td>
<td>10 (40.0%)</td>
<td>3 (12.0%)</td>
<td>0 (0.0%)</td>
<td>0 (0.0%)</td>
<td>1.688</td>
</tr>
<tr>
<td>I teach students the use of charts so that they can break information to understandable pieces.</td>
<td>11 (44.0%)</td>
<td>6 (24.0%)</td>
<td>5 (20.0%)</td>
<td>2 (8.0%)</td>
<td>1 (4.0%)</td>
<td>2.040</td>
</tr>
<tr>
<td>I put more emphasis on the use of multiple representations such as tables, symbols, graphs and words.</td>
<td>8 (32.0%)</td>
<td>13 (32.0%)</td>
<td>2 (8.0%)</td>
<td>1 (4.0%)</td>
<td>1 (4.0%)</td>
<td>1.960</td>
</tr>
<tr>
<td>I don’t use math games for algebraic practice with my student.</td>
<td>12 (48.0%)</td>
<td>10 (40.0%)</td>
<td>3 (12.0%)</td>
<td>0 (0.0%)</td>
<td>0 (0.0%)</td>
<td>1.640</td>
</tr>
<tr>
<td>I use diagrams to enable the students solve different equations.</td>
<td>11 (44.0%)</td>
<td>10 (40.0%)</td>
<td>2 (8.0%)</td>
<td>1 (4.0%)</td>
<td>1 (4.0%)</td>
<td>1.840</td>
</tr>
<tr>
<td><strong>Overall mean</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td><strong>1.87</strong></td>
</tr>
</tbody>
</table>

From the findings, majority of the teachers, 84% give their pupils math games for algebraic practice, as shown by a mean of 1.640; 88.0% did not teach pupils to represent problems with tables, as shown by a mean of 1.688; 84.0% did not use make use of diagrams to assist the students in solving different equations, as shown by a mean of 1.840; 80.0% did not teach pupils to represent algebraic equations with graphs, as shown by a mean of 1.920; 64.0% did not put more emphasis on the use of multiple representations such as symbols, words, graphs and tables, as shown by a mean of 1.960; 76.0% did not encourage pupils to use cubes, beam balance or blocks to represent
algebraic equations, as shown by a mean of 2.000; and 68.0% of the teachers did not instruct on the use of charts for breaking down problems into understandable pieces, as shown by a mean of 2.040.

4.3.6 Widely used pedagogic strategies in teaching algebra in upper primary classes
To establish the widely used pedagogic strategies in teaching algebra Analysis of variance (ANOVA) of the mean responses was carried out. The result showed that there was a significant difference in the pedagogical strategies used by teachers ($F = 427.53$, $P = 0.0001$). Cooperative learning (mean 3.86) and direct learning (mean 3.78) were significantly higher than problem based learning (mean 1.81) and representation (mean 1.87). The higher the mean response recorded the more the teachers agreed to use particular strategy.

4.4 To establish the factors influencing the teachers’ choice of pedagogic strategies in learning of algebra.
4.4.1 Strategies in learning of algebra
The students were requested to indicate their opinion on statements relating to Mathematics lesson they learn.
Table 4.7: Students’ opinions on learning algebra

<table>
<thead>
<tr>
<th>Statement</th>
<th>Never</th>
<th>Sometimes</th>
<th>Often</th>
<th>Very Often</th>
<th>Always</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>How much time in hours do you spend studying or doing Mathematics questions on algebra?</td>
<td>2</td>
<td>17</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>2.360</td>
</tr>
<tr>
<td>How frequent do you tackle algebra questions without teachers’ guidance during the lesson or when doing private study?</td>
<td>5</td>
<td>15</td>
<td>3</td>
<td>2</td>
<td>0</td>
<td>2.080</td>
</tr>
<tr>
<td>How often do you discuss algebraic questions with your friend?</td>
<td>3</td>
<td>17</td>
<td>4</td>
<td>1</td>
<td>0</td>
<td>2.120</td>
</tr>
<tr>
<td>How often do you have your book marked during math’s class?</td>
<td>10</td>
<td>6</td>
<td>5</td>
<td>2</td>
<td>2</td>
<td>2.200</td>
</tr>
<tr>
<td>How often are you assigned algebraic questions as homework?</td>
<td>8</td>
<td>13</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1.960</td>
</tr>
<tr>
<td>How often are you asked to solve equations in your Mathematics class?</td>
<td>12</td>
<td>10</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>1.640</td>
</tr>
<tr>
<td>How often are you grouped by the teacher in solving algebraic problem in Mathematics?</td>
<td>1</td>
<td>17</td>
<td>2</td>
<td>4</td>
<td>1</td>
<td>2.480</td>
</tr>
<tr>
<td>Overall mean</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2.12</td>
</tr>
</tbody>
</table>

From the study findings, majority of the students, 48.0% indicated that their Mathematics teachers never asked them to solve equations during Mathematics lesson, as shown by a mean of 1.640; 52.0% students indicated that sometimes their teachers assigned algebraic questions as homework, as shown by a mean of 1.960; 60.0% of the students indicated that they sometimes tackled algebra questions without teachers guidance during the lesson or when doing private study, as shown by a mean of 2.080; 68.0% which indicated that they sometimes discussed algebraic questions with their friends as shown by a mean of 2.120; 40.0% of the students never have their books marked during Mathematics class, as shown by a mean of 2.200. The result further established that 68.0% of the students sometimes study or do Mathematics questions on algebra, as
shown by a mean of 2.360 and that they are sometimes grouped by the teacher in solving algebraic problem in Mathematics, as shown by a mean of 2.480. The students also indicated that their teachers begin the lesson by revising the previous lesson taught. The study revealed that the Mathematics teachers involve students in the learning of algebra by asking and answering questions, discussing, as well as group work.

4.4.2 Multiple representations as a factor influencing the teachers’ choice of the strategies in learning of algebra.
Observations on the extent to which Multiple Representations were used by the teachers were made as the teachers were teaching algebra. Results showed that the same problem may be seen from algebraic, arithmetical, and geometrical perspectives. It was observed that teachers gave few examples ranging between three to six examples per lesson.

4.4.3 Teachers’ knowledge of Algebra
Observations on whether the teachers had adequate knowledge of Algebra revealed that they had difficulties in solving Algebraic equations which could be related to their difficulties and misinterpretation of symbolic notations. Based on these findings the study deduces that teachers lacked sufficient knowledge in teaching of algebraic concepts. The teachers’ knowledge and understanding of algebraic concepts are therefore not good enough to assist learners as far as learning for conceptual understanding is concerned at schools.
4.4.4 Involving learners in solving Mathematics problems

From the interview schedule with the teachers, the frequency at which teachers involved learners in solving mathematical problems showed that pupils were highly engaged during algebra class. This was commonly done through group discussion and instances where pupils were required to solve problems on the black board.

During the teachers’ interview, on the performance of pupils in algebra lessons, it came out that most of the pupils had difficulties in grasping the algebraic concepts and that generally most of the pupils’ performance was relatively below the average level. The teachers further suggested during the interview that factors contributing to the current pupils’ poor performance in algebraic lessons, among other factors cited include: lack of adequate instructional material, lack of required text books and reference books which were inadequate and high teacher pupil ratio per class.

4.4.5 Intervention measures put in place to enhance teaching and learning of Algebra in Class

Results from teachers’ interview on intervention measures which teachers have put in place to enhance teaching and learning of algebra, revealed that most of the teachers and especially class teachers had developed local practical teaching models that pupils could understand easily rather than the ones provided by the syllabus. Further, the teachers indicated that they were mobilizing parents to finance on teaching material that the school could not afford.
4.4.6 Nature of Support Teachers get from the School Administration in Teaching of Algebra

Results from the interview showed that majority of the teachers get support from the school administration in support of algebra lessons. The teachers indicated that the management of schools ensured provision of teaching materials, provision of motivational incentives to pupils and mobilization of positive culture toward algebra and math’s subject in general. Teachers interviewed indicated that upper primary teachers highly consulted with lower primary teachers, in order to ensure that fundamental bases of Mathematics and especially in algebra were instilled to pupils. This was perceived to influence pupils understanding of algebra in future.

4.4.7 How frequently teachers prepared teaching plans of Algebra and Mathematics in general

Results from teachers interviewed showed that majority of the teachers always prepared teaching plans earlier before the lesson. This was observed to ensure that teachers covered every bit and enhance the overall effectiveness of the lesson. During Algebra class, some of the concepts in algebra that were emphasized most, so that learners may grasp the algebraic concepts with ease were; that teachers made sure that pupils mastered prerequisite skills prior to learning algebra. These skills include but are not limited to basic facts, problem solving skills, and probability skills. It was very necessary to review these skills prior to working with algebra concepts. The study also established that teachers tried to relate algebra problems to real-life situations.
4.4.8 Duration of Mathematics Lesson

Results from physical observation on duration of the lesson showed that in most schools every Mathematics lesson took between 35 to 40 minutes. On the number of learners in a class, it was observed that a maximum of 69 pupils and a minimum of 24 pupils were in a class. This number according to the observer was complex to manage.

Table 4.8: Teaching Approach used by the teachers

<table>
<thead>
<tr>
<th>Teaching Approach</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teacher-Centered</td>
<td>24</td>
<td>70.6</td>
</tr>
<tr>
<td>Learner-Centered</td>
<td>10</td>
<td>29.4</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>34</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>

Results from physical observation on the teaching approach adopted by teachers showed that, majority of the teachers had adopted Teacher-centered teaching approach as shown by a 70.6% whereas only 29.4% had adopted learner-centered teaching approach.

Table 4.9: Learner active involvement and participation

<table>
<thead>
<tr>
<th>Learner active involvement</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Active</td>
<td>27</td>
<td>79.4</td>
</tr>
<tr>
<td>Inactive</td>
<td>2</td>
<td>5.9</td>
</tr>
<tr>
<td>Inattentive</td>
<td>5</td>
<td>14.7</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>34</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>

Results from physical observation on Learner active involvement and participation showed that majority of the learners, 79.4% were actively involved during learning exercise. However, 14.7% of the learners were inattentive whereas about 5.9% of the learners were totally inactive. This implies that majority of the teachers actively involved learners during Mathematics lessons in algebra.
4.4.9 Introduction of 'New' Algebraic Concept Not Previously Known to Learners

Results from physical observation on introduction of 'new' algebraic concept not previously known to learners showed that in most of the schools, Mathematics teachers performed excellently in the first stage of introduction of 'new' algebraic concept not previously known to learners but the same decreased as teachers went deeper to the lesson core subjects.

4.4.10 Challenges in Teaching of Algebra Lesson

Results from the teachers interviewed on challenges teachers experience in teaching of algebra lesson include, lack of enough teaching materials, high population of pupils, lack of elementary basics by pupils from lower primary, lack of motivation and dyscalculia problem among pupils. Because of the challenges, they experience, the teachers were found to put in place some measures to overcome them.

4.4.11 Strategies Put in Place to Overcome Challenges in Teaching of Algebra Lesson

Results from interviewees on the strategies put in place to ensure they overcome challenges in learning of algebra, were that most of the Teachers first ensured that they understand algebra well enough to teach it to their pupils. Most of the teachers ensured effective teaching behaviors (e.g., specific praise, questioning) are included in all lessons, ensured error analysis was done by examining the problems, or by interviewing pupils and asking them to demonstrate what they have done. The use of concrete materials or
manipulative was employed to assist pupils in understanding the abstract level of algebra. These manipulative objects included algebra tiles, age blocks, or other items.

4.5 To establish the pedagogic strategy that contributes most to pupils learning of algebra in upper primary classes

4.5.1 How Algebraic Concepts Were Defined and Explained and Developed Over Time

Results from physical observation on how algebraic concepts are defined, explained and developed over time showed that, lack of pedagogical content knowledge in algebra by majority of teachers examined during the math’s lessons reflects a deeper problem pertaining to pupils’ understanding. This is bound to have a cascading effect on teaching and learning in schools, perpetuating the poor performance specifically in algebra at the National level. As observed in this study, unless something radical is done about the teaching and learning of algebra, the same trend in performance is likely to prevail.

4.5.2 Observing whether Algebraic Concepts are introduced informally

Results from physical observation on whether algebraic concepts were introduced informally showed that procedural teaching was observed in most of the lessons. Teachers carefully demonstrated algorithms, explaining each step and then provided opportunities for the learner to practice the algorithms individually, which they had mastered. Activities were mostly drawn from textbooks. To assess their learners, teachers sometimes went around the classroom as the learners were working and either ticked it correct or wrong without checking where the mistake had come from. Further it was
observed that a few of the teachers taught for conceptual understanding but struggled with conceptual explanations like what they did in case of procedural understanding.

4.5.3 Learners’ activities during the Lesson discussion
An observation on what learners did during the lesson discussion was made. Results from physical observation on what the learners did in the lesson discussion showed that, during lesson discussion pupils in most of the schools were given an opportunity to learn how to solve algebraic expressions and equations containing letters, numerals, operation signs and brackets.

4.5.4 Pedagogical strategy that contributes most to pupils learning of algebra in upper primary classes
In evaluation of the most effective pedagogical strategies that contributes most to pupils learning of algebra, a chi-square test was conducted. The result showed that there was a significant association ($\chi^2 = 29.001$, $P = 0.031$). Cooperative learning in Algebraic concept contributed more to pupils learning than other strategies.
CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter gives a summary of the study’s findings, the conclusion from the provided findings and the recommendations made. The recommendation and conclusions reached were mainly focused in meeting the study’s objectives. The researcher had sought to come up with widely used pedagogic strategies in teaching algebra in upper primary school classes, to establish the factors influencing the teachers’ choice of pedagogic strategies in learning of algebra and to establish the pedagogic strategy that contributes most to pupils’ learning of algebra in upper primary classes.

5.2 Summary of the Study

5.2.1 Mathematics Lessons

The study sought to determine the number of Mathematics lessons the teachers are allocated in each week. The teachers indicated that they are allocated seven Mathematics lessons in a week. This is because Mathematics is taught in every day of the week. The teachers also indicated that their class had an average number of 45 students, and that in Mathematics the pupil to textbook ratio in their classes was 1:4. The teachers further rated the students’ scores in the subject as average. This Mathematics poor performance can be said to be due to large class sizes and the inadequacy of the Mathematics textbooks.
5.2.2 Teachers Choice of Teaching Strategies

The teachers were requested to rate the use of some teaching strategies according to their importance in influencing students learning of algebra in their class. The findings showed that all the teaching strategies were being used by Mathematics teachers in teaching Mathematics, with the Cooperative Learning being the most frequently used. The findings were found to concur with the findings of Slavin (1983), who argued that NCTM supports cooperative learning and is beneficial to students with or without learning disability in Mathematics achievement. This is because through cooperative learning, the students are able to learn better by being more actively involved in learning than by learning through the traditional means of listening and watching.

5.2.3 An Investigation of Instructional Practices for Algebra

The teachers were requested to indicate their agreement level with statements given that were related to various teaching strategies. The study revealed that teachers: assign pupils to work in heterogeneous groups, work with the students in collaboration when looking for problem solutions, allow pupils to use their skills in cooperative problem solving to find solutions to problems, direct students to work in groups that are homogeneous in nature, do not pair pupils to work as peer tutors, ensure that excellent group performances achieved in cooperative learning settings are rewarded, and that allow pupils to discuss with their peers on solutions relating to problems in algebra. These findings show that the Mathematics teachers have emphasized the use of cooperative learning strategy in teaching Mathematics in their school. These findings concur with those of Slavin (1983).
who asserted that involving learners in cooperative learning with the teacher’s guidance and monitoring may help learners achieve and comprehend mathematical concepts.

5.2.4 Findings from the Students

The study revealed that many students agreed that they sometimes: are asked to solve equations in their Mathematics class, are assigned algebraic questions as homework, tackle algebra questions without teachers guidance during the lesson or when doing private study, discuss algebraic questions with their friends, have their books marked during Mathematics class, study or do Mathematics questions on algebra, and that they are sometimes grouped by the teacher in solving algebraic problem in Mathematics. The students also indicated that their teachers begin the lesson by revising the previous lesson taught. The study revealed that the Mathematics teachers involve students in the learning of algebra by asking and answering questions, discussing, as well as group work.

5.3 Conclusion

The study revealed that the teachers are allocated seven (7) Mathematics lessons in a week and that their classes have an average number of 45 students, with the pupil to textbook ratio as 1:4. The teachers further rated the students’ performance in Mathematics as average. The study concludes that Mathematics poor performance by pupils is as a result of the large class sizes and the inadequacy of the Mathematics textbooks.
The study further revealed that all the teaching strategies were being used by Mathematics teachers in teaching Mathematics, with the Cooperative Learning strategy being the most frequently used. Moreover, strategies in teaching Mathematics such as Visual Representations require more resources than the use of textbooks. Other strategies such as direct instruction are effective when class size is small.

The findings also revealed that students sometimes discuss algebraic questions with their friends and sometimes have their books marked during Mathematics lesson. The study therefore draws further to conclude that poor performance in students can be attributed to their lack of active participation in the Mathematics classroom.

5.4 Recommendations

The study recommends that the school management should ensure that they buy more Mathematics textbooks so as to reduce the ratio of textbook to students. The management should also consider allocating funds to building of more classes so as to reduce that teacher-student ratio. This will make it easier for teachers since smaller classes are easy to handle.

The research further recommends that Mathematics teachers should consider organizing students into small group discussions since increased students’ verbalization increases students’ responsibility for their own learning. However, proper guidance and monitoring by teachers should be observed because without motivational practices during classroom discussion, mastery of skills and concepts may be futile.
The study further concluded that Mathematics teachers should put extra efforts in encouraging students to actively participate in class. Students should be motivated to tackle algebra questions without teachers’ guidance during the lesson or when doing private study, as well as discuss algebraic questions with their friends. This will improve their interest toward the subject.

5.5 Recommendation for Further Research

The study sought to establish pedagogic strategies that teachers use in teaching algebraic concepts in Laikipia West sub-County, the study recommends that a similar research should be done this time focusing on wider geographical area.

There is need to investigate the effectiveness of methodologies being used to deal with dyscalculia effect on pupils in Laikipia West sub-County.
REFERENCES


Orodho, A. J. (2003). *Essential of Educational and Social Science Research Methods*: Masola Publisher


Primary school syllabus Volume II (2002). Ministry of education


APPENDICES

Appendix A: Questionnaires for Mathematics Teachers in Upper Primary Classes.
The questionnaire is aimed at establishing the pedagogic strategies practiced in teaching of algebra in primary schools in Kenya. I would be very grateful if you could go through it for a moment. Please read and answer the questions herein as truthfully as possible and tick [√] as appropriate. The information you will give will be treated with utmost confidence.

Section A: General Information

1. What is your gender? Male [ ] Female [ ]

2. Age? 18- 25 [ ] 26- 33 [ ] 34- 41 [ ] 42-49 [ ] 50 and above [ ]

3. Highest level of education?
   O level [ ] Diploma [ ] Bachelor’s Degree [ ] Postgraduate Degree [ ]

4. Length of service in years
   Below 1 [ ] 1-5 [ ] 6-10 [ ] 11-15 [ ] 16-20 [ ] 20 and above [ ]

5. Class you handle Mathematics
   STD 1- 3 [ ] STD 4- 5 [ ] STD 5- 6 [ ] STD 6- 7 [ ] STD 7- 8 [ ]

6. Number of years in teaching
   (If < 1 yrs put 0)
   A. In this school [ ]
   B. In teaching profession [ ]

7. Trained Yes [ ] No [ ]
Section B: Mathematics Lesson

1. How many lessons are allocated for you to teach per week? ........................................

2. What is the Mathematics teaching load per week? ........................................

3. What is your average class size? .................................................................

4. What is the Mathematics pupil: textbook ratio in your class?

5. How can you rate your pupils’ performance in Mathematics?
   
   Below average [ ] Average [ ] Above average [ ] Not consistent [ ]

Section C: Teachers Choice of Teaching Strategies

Please rate the following use of teaching strategies in teaching according to their
importance in influencing students learning of algebra in your class. The most frequently
used is rated one (1), least five (5) and not applied is zero (0).

<table>
<thead>
<tr>
<th>Teaching strategy</th>
<th>Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cooperative learning</td>
<td></td>
</tr>
<tr>
<td>Problem based learning</td>
<td></td>
</tr>
<tr>
<td>Direct instruction</td>
<td></td>
</tr>
<tr>
<td>Problem solving</td>
<td></td>
</tr>
</tbody>
</table>

Any other, please specify

i. ........................................

ii. ........................................

iii. ........................................
Section D: An Investigation of Instructional Practices for Algebra

For each of the following statements, please circle to select the best, the number of times you use this teaching method. On the right hand side of each of the statements below, rate your school using a scale of 1 to 5. The rating scale has five positions meaning; 5- Strongly Agree, 4- Agree, 3- Not Sure, 2- Disagree, 1- Strongly Disagree.

The ratings will qualify your judgment.

**Domain and description**

1. **Cooperative learning:** a method of instruction in which pupils work together to reach a common goal.

2. **Problem based learning:** teaching through problem solving where pupils apply a general rule (deduction) or draw new conclusions or rules (induction) based on information presented in the problem.

3. **Manipulative, models and multiple representations:** teaching pupils techniques for generating or manipulating representations of algebraic content or processes, whether concrete, symbolic or abstract.

4. **Direct instruction:** setting objectives and providing feedback. Teaching through establishing a direction and rationale for learning by relating new concepts to previous learning leading pupils through a specified sequence of instructions based on predetermined steps that introduce and reinforce a concept, and providing pupils with feedback relative to how well they are doing.
<table>
<thead>
<tr>
<th>Cooperative Learning</th>
<th>Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. I collaborate with the whole class in finding a solution to a problem.</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>2. I allow pupils to engage in cooperative problem solving.</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>3. I allow pupils to discuss solutions to algebra problems with peers.</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>4. I don’t pair pupils to work as peer tutors.</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>5. I reward group performance in the cooperative setting.</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>6. I assign pupils to work in homogeneous groups.</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>7. I assign pupils to work in heterogeneous groups.</td>
<td>1 2 3 4 5</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Problem-based Learning</th>
<th>Ratings</th>
</tr>
</thead>
<tbody>
<tr>
<td>8. I have pupils create their own rules in new problem solving situations.</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>9. I draw mathematical concepts from &quot;real-life&quot; situations.</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>10. I have pupils pursue open-ended and extended problem solving projects.</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>11. I create problems from the interests of individual pupils.</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>12. I don’t recognize many alternative problem-solving practices.</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>13. I emphasize the problem solving process, rather than the solution.</td>
<td>1 2 3 4 5</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Direct Instruction</th>
<th>Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>14. I use pre-worked examples to introduce or reinforce topics.</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>15. I close instruction by reviewing concepts with pupils, emphasizing comparisons to previously covered concepts</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>16. When providing feedback, I target incorrect responses and error</td>
<td>1 2 3 4 5</td>
</tr>
</tbody>
</table>
I identify a new skill or concept at the beginning of instruction and provide a rationale for learning it.

I provide a sequence of instruction, moving pupils from concrete to abstract concepts in defined steps.

I require pupils to indicate a one-step-at-a-time process in working equations.

I don’t grade homework to provide feedback.

When assigning practice work, I ensure that the majority of the problems review previously.

<table>
<thead>
<tr>
<th>Manipulative, Models, and Multiple Representations</th>
<th>Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>22. I encourage pupils to use cubes, beam balance or blocks to represent algebraic equations.</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>23. I teach pupils to represent algebraic equations with graphs.</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>24. I teach pupils to represent problems with tables.</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>25. I teach pupils to represent problems with charts to break information into smaller pieces.</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>26. I emphasize the use of multiple representations: words, tables, graphs, and symbols.</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>27. I don’t provide math games for pupils to practice algebraic skills.</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>28. I use diagrams to help pupils learn to solve equations.</td>
<td>1 2 3 4 5</td>
</tr>
</tbody>
</table>

Thank you very much for filling in this questionnaire as accurately and truthfully as possible!
Section E: Teachers Interview schedule.

1. How would you rate the performance of your pupils in algebra?
2. What could have contributed to this performance?
3. How frequent do you involve learners in solving mathematical problems?
4. What intervention measures have your school put place to enhance teaching and learning of algebra?
5. What kind of support do you get from the school administration in support to your teaching of algebra?
6. How do you involve those teachers who teach in lower primary classes in emphasizing the teaching of algebra?
7. As a Mathematics teacher how frequent do you prepare or plan for teaching of algebra?
8. What challenges do you experience in teaching of algebra lesson?
9. What strategies do you put in place to overcome these challenges?
10. Which concepts in algebra do you emphasize most so that learners may grasp the algebraic concepts with ease?

Section F: Lesson Observation Schedule

Complete the information required for 1-5

To be filled by the researcher while observing the lesson proceedings. The purpose of this instrument is to help the researcher find out how Mathematics teachers teach during Mathematics lesson.

1. Date
2. school
3. Gender of the teacher

4. Topic of the algebra lesson

5. Duration of lesson

6. Number of learners

7. Type of teaching approach: (a) Teacher-centered (b) learner-centered

8. Learner active involvement and participation: (a) active (b) passive (c) inactive (d) inattentive

Provide comments for 8-14

9. Introduction of 'new' algebraic concept not previously known to learners:
   Comments:

10. Observing how algebraic concepts are defined and explained and developed over time:   Comments:

11. Observing whether algebraic concepts are introduced informally.   Comments:

12. Observing to what extent multiple representations are used so that the same problem may be seen from algebraic, arithmetical, and geometrical perspectives.   Comments:

13. Did the teacher have adequate knowledge of algebra?   Comments:

14. What do the learners do in the lesson discussion? What does the communication with the teacher suggest about their algebraic understanding?
Appendix B: Students Questionnaire in the Upper Primary Classes

PATR 1: Student Achievement Tests in Algebra.

Time: 15 minutes.

1. There are \( m \) men in a bus. The number of children in the bus was three times that of men but eleven more than that of women. The total number of women, men and children in the bus was 45. Which one of the equations below can be used to find the number of men that were there in the bus?
   
   A. \( 5m - 11 = 45 \)  
   B. \( 4m + 11 = 45 \)  
   C. \( 7m + 11 = 45 \)  
   D. \( 7m - 11 = 45 \)  

2. Simplify the following:
   
   a) \( 4(4s+2s-s+2s-5s) \)
   
   b) \( 12x+3y+2y-6x \)

3. Solve the equations:
   
   a) \( 7a=21 \)
   
   b) \( 6c+5c=99 \)
   
   c) \( 7y-4y=21 \)
   
   d) When \( p \) is multiplied by nine the result is twenty seven. What is \( p \)?

4. Use the symbols \(<\), \(>\) and \(=\) in the spaces provided to make the statement true. E.g. \(15>3\)
   
   a) 1000 half litres ................. 500 litres.
   
   b) Forty minutes ............... three quarter of an hour.
   
   c) 1 km ............... 10 meters.
Part 2: Pupils Questionnaires

Please respond to this questionnaire honestly by ticking (√) in the appropriate box in the table below. Your response will be treated confidentially and will only be used by the researcher.

<table>
<thead>
<tr>
<th>Statement</th>
<th>Never</th>
<th>Sometimes</th>
<th>Often</th>
<th>Very often</th>
<th>Always</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. How much time in hours do you spend studying or doing Mathematics</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>questions on algebra?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. How frequent do you tackle algebra questions without teachers</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>guidance during the lesson or when doing private study?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. How often do you discuss algebraic questions with your friend?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. How often do you have your book marked during math’s class?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. How often are you assigned algebraic questions as homework?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. How often are you asked to solve equations in your Mathematics class?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. How often are you grouped by the teacher in solving algebraic problem</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>in Mathematics?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. Which activity does your teacher use at the beginning of the lesson?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
By revising the previous lesson taught [ ]

Without revising the previous lesson taught [ ]

9. In which way does your Mathematics teacher involve you in the learning of algebra during math’s lesson, by?

- Asking and answering questions [ ]
- Discussing [ ]
- Group work [ ]
- Student demonstrating on the chalkboard [ ]

*Thank you very much for filling in this questionnaire as accurately and truthfully as possible!*
Appendix C: Research Permit

NATIONAL COMMISSION FOR SCIENCE, TECHNOLOGY AND INNOVATION

Telephone: +254-20-2213471, 2241349, 310571, 2219420
Fax: +254-20-318245, 318249
Email: secretary@nacost.go.ke
Website: www.nacost.go.ke
When replying please quote

Ref: No.

NACOSTI/P/15/3183/5031

Samuel Wang’ombe Mwangi
Kenyatta University
P.O. Box 43844-00100
NAIROBI.

RE: RESEARCH AUTHORIZATION

Following your application for authority to carry out research on “Pedagogic strategies influencing pupil’s learning of algebraic concepts in upper primary school classes in Laikipia West Sub County, Laikipia County, Kenya,” I am pleased to inform you that you have been authorized to undertake research in Laikipia County for a period ending 31st December, 2015.

You are advised to report to the County Commissioner and the County Director of Education, Laikipia County before embarking on the research project.

On completion of the research, you are required to submit two hard copies and one soft copy in pdf of the research report/thesis to our office.

DR. S. K. LANGAT, OGW
FOR: DIRECTOR GENERAL/CEO

Copy to:

The County Commissioner
Laikipia County.

The County Director of Education
Laikipia County.
CONDITIONS:

1. You must report to the County Commissioner and the County Education Officer of the area before embarking on your research. Failure to do that may lead to the cancellation of your permit.

2. Government Officers will not be interviewed without prior appointment.

3. No questionnaire will be used unless it has been approved.

4. Excavation, filming and collection of biological specimens are subject to further permission from the relevant Government Ministries.

5. You are required to submit at least two (2) hard copies and one (1) soft copy of your final report.

6. The Government of Kenya reserves the right to modify the conditions of this permit including its cancellation without notice.
THE PRESIDENCY
MINISTRY OF INTERIOR & CO-ORDINATION OF NATIONAL GOVERNMENT

Ref No.

CC.ED.12/14/VOL.I/31

29th June 2015

SAMUEL WANGOMBE MWANGI
KENYATTA UNIVERSITY
P O BOX 43844-00100
NAIROBI

RE: RESEARCH AUTHORIZATION


Following your authorization by the National Commission for Science, Technology and Innovation to carry out research on “Pedagogic strategies influencing pupils learning of algebraic concepts in upper primary school classes in Laikipia West Sub County, Laikipia County,” this office has no objection for you to undertake the research.

By a copy of this letter our officers are requested to give you all the necessary support you may need to make your research a success.

WILSON O. WANYANGA, MBS
COUNTY COMMISSIONER
LAIKIPIA

Cc:
Deputy County Commissioner
Laikipia West Sub County
The Director General
National Commission for Science, Technology & Innovation
P. O. Box 30623-00100
NAIROBI.

Dear Sir/Madam,

RE: RESEARCH AUTHORIZATION
SAMUEL WANG'OMBE MWANGI.

We acknowledge receipt of the above Ref: NACOSTI/P/15/3183/5031 dated 20th March, 2015.

C.C
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