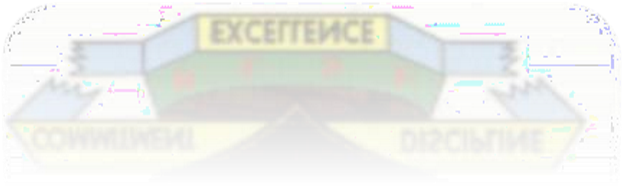
**BINDURA UNIVERSITY OF SCIENCE EDUCATION**

**FACULTY OF SCIENCE EDUCATION**

**DEPARTMENT OF EDUCATION**



**INVESTIGATING CHALLENGES FACED BY PUPILS WHEN SOLVING LINEAR**

**EQUATIONS. THE CASE OF GLOBE AND PHOENIX SECONDARY SCHOOL IN KWEKWE TOWN.**

**PRESENTED BY**

**SIYAFA CHRISTINA**

**(B1645318)**

**SUBMITTED TO THE DEPARTMENT OF EDUCATION, BINDURA UNIVERSITY OF SCIENCE EDUCATION IN PARTIAL FULFILMENT OF THE**

**REQUIREMENTS OF BACHELOR OF EDUCATION HONOURS DEGREE IN MATHEMATICS**

**SUPERVISOR: DR CHAGWIZA**

**JANUARY 2021**

1

# APPROVAL FORM

Investigating challenges faced by pupils when solving linear equations. The case of Globe and Phoenix Secondary School in KweKwe town.

I certify that this dissertation meets the preparation guidelines as presented in the Faculty Guide and Instructions for Typing Dissertations

Christina Siyafa **Date** \_\_\_ /\_\_\_\_ / 2021

(***Signature of Student***)

1. **To be completed by the Supervisor:**

This dissertation is suitable for submission to the faculty

This dissertation should be checked for conformity with the faculty guidelines

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# DEDICATION

This research project is dedicated to my family for the sacrifices and support throughout the study. My husband’s spiritual support and mentorship inspired me. To my family, thank you for all the love, support and patience over the years. May the Almighty God greatly bless you and award abundantly. I love you all.

# ACKNOWLEDGMENT

I would like to take this opportunity to extend my heartfelt and profound credit to my supervisor Dr Chagwiza for his encouragement, guidance, professional support and patience he showed for the succession of the research project. I owe my gratitude to the Science Education lectures for the valuable knowledge they gave which cannot be taken away from me.

I would also like to thank the Headmistress of Globe and Phoenix Secondary School, Mrs. P. Mguquka and her staff Mr. A Chuma and Mrs. S. Nzvenge for their support and cooperation during my research and also allowing me to conduct the research at their school. I also want to thank my fellow students for their motivation and support.

# ABSTRACT

The research investigated the challenges faced by FORM 3 learners in solving linear equations at Globe and Phoenix Secondary School, Midlands Province, KweKwe District. The research objectives were to identify the linear equations that learners find most challenging and deduce solutions that can be implemented to improve learners understanding of linear equations. A qualitative research design was adopted in the study. Purposive sampling was administered in selecting the mathematics teachers and Globe and Phoenix Secondary school. A total of four mathematics teachers were interviewed in November 2021. Semi structured interview guides were used to collect the teacher’s opinions. The interview notes were subjected to thematic analysis, to establish key themes from the teacher’s responses. The results showed the fundamental challenges faced by learners in teaching and learning of linear equations. Among the challenges faced were: not able to interpret word problems correctly because of language difficulties , difficulty in processing iconic and visual representation of mathematical knowledge ,deficiency of requisite skills ,incorrect association or rigid that is negative transfer caused by decoding and encoding information failure to treat addition and multiplication of two or more variables differently well as teachers who are reluctant to change from the traditional methods to teaching to the use of ICT. The researcher made some recommendations on investigating challenges faced by pupils when solving linear equations. Among the recommendations was that teachers should vary their teaching methods to enhance learners’ participation and performance. Programmes and/or interventions supporting group work as a teaching strategy to effective learning of mathematics were recommended*.*

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In this chapter the study will focus on statement of the problem, limitations, delimitations, research objectives, assumptions of the study, theoretical framework, significance of the study and definition of terms.

**1.0 Background**

Mathematics is an important tool for the development and improvement of a person’s intellectual competence in logical reasoning, spatial, visualisation, analysis and abstract thought, when learners have acquired enough knowledge in mathematics they develop numeracy, reasoning, thinking skills and problem-solving skills Chi et al (2005). In the Zimbabwean school curriculum, mathematics is one of the core subjects in all options for both the academic and the practical career pathways. As a result, there is always a greater pressure on learners to succeed in mathematics than there is any other subject.

Development is based on effective knowledge of science and mathematics Slota (2015) and it is for this reason that the education system emphasis on the study of mathematics. Mathematics is a basic knowledge needed by students to extend their learning to higher levels. Mathematics is required in our daily lives regardless of our educational background and social life. The benefits of mathematics are not only limited to knowledge in computation but it also helps individual to think rationally and critically. The principles of mathematics enable people to see problems as facts not fiction. The mathematics syllabus is based on the premise that all students could read mathematics and that all need to learn it. The National council of Teachers of Mathematics (2000) emphasized the goal of mathematics education reform is to produce students who are skilled in resolving problems, fostering attitudes, interest and high motivation towards mathematics. Learners should be exposed to skills in interpreting problems, planning solutions strategy, implementation of plan and rechecking of answers. In order for the students to think mathematically students should be exposed to various strategies of problem solving by doing each step carefully and systematically

Despite the importance of mathematics, there lies myriad challenges in the teaching of linear equations. Algebraic linear equations are one of the major content domains covered to promote the acquisition of mathematical knowledge and skills in the domain of mathematics, linear equations focus on generalization and interpretation of patterns and relationships. The knowledge of linear equations is so important that its utility is needed by everyone. The word problem is one variable that is translated into standard problem and solve. The standard problems which are taught to learners before word problem are defined as tasks or exercises in linear equation problems in one variable without or with very few words stating the mathematical tasks involved.

Solving linear equations is an important algebraic concept, students must be able to solve equations while understanding the process, justifying and explaining the steps. The researcher proposed that exposing the challenges will call for interventions that will eventually lead to improved quality of learning mathematics and its application in real life. Despite the perceived usefulness of mathematics, they are challenges faced by learners in solving linear equations and the study sought possible solutions to mitigate the identified problems.

Forms of linear equations

Slope – intercept y= mx+b

Point-slope y-𝑦1=m(x-𝑥1)

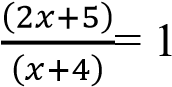
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**1.1.0 Examples of linear equations**

1. The length of a rectangle is twice its breadth, if the perimeter is 72 metres find the length and breadth of the rectangle
2. The sum of two consecutive multiples of 5 is 55find these multiples
3. The difference between the two numbers is 48. the ratio of the two numbers is 7:3 what are the two numbers

Difficulties: learners fail to understand the demand of the question because of lack of good comprehension skills

Solve the equation

* + 1. -3(x-7) +5(2-4x)
    2. 
    3. Simplify as far as possible

3(6x-5) = -2(4x-7)

* + 1. Solve the simultaneous equation
    2. 4x-2y=16
    3. 3x+2y=19

Leaners may fail to apply elimination or substitution correctly

* + 1. 3x + 6 = 2y -4

The researcher decides to carry out a study on causes of poor performance in solving linear equations to generate ideas to reduce the rates of these conditions. Culture and learners ‘background can also be part of great significance in accepting of mathematics.

Lemmer (2000 p34) “Mathematics, Science and Technology are strongly influenced by the global context and in that proficiency in these disciplines is a pre-requisite to economic success” Regardless of the social economic limitations, some observations at the school can also contribute as challenges faced by pupils in learning Mathematics.” The study of this subject will provide the basis of judgement and taking action on matters related to mathematics in their everyday lives. In this vein Sciences (Mathematics) are very crucial in understanding the world beyond us. It challenges our imagination with those leads to great discoveries that changes one’s life.

The problem drew the researcher’s attention during a lesson in Form 3 when she was teaching linear equation in Mathematics at Globe and Phoenix secondary school. The researcher observed that learner’s performance in solving linear equations especially the equations involving word problems was not satisfactory. Learners who were getting good marks in other topics could not score high in linear.

* 1. **Statement of the Problem**

Learners are failing to comprehend linear equations as evidenced by poor performances in the topic. This is worrying considering that knowledge of the linear equations is useful in tackling some other mathematical problems such as equations and factorisation. Linear equations are also useful in other science subjects such as Chemistry, Physics and Biology. When learners fail to understand and solve linear equations, they then fail to tackle questions in the other subjects as well. This contributes to the notion that science and mathematics are difficult subjects hence learner’s enrolment and participation in science decreases. This is against government efforts to increase learner’s participation in science through the STEM curriculum. There is therefore need to identify the problems that learners are facing in solving linear equations and also to come up with suggested solutions to stated problems so that learner’s performance and participation in science as a whole is enhanced. Learners face many challenges as they study algebra one important area of the study within the subject of algebra is solving linear equations. Within the topic of solving linear equations student struggle to develop symbolic understanding, to form an equal sign and to balance conceptual and procedural knowledge

* 1. **Research questions**

1. Which challenges faced by learners in linear equations at form 3from teachers’ perspective?
2. What are the possible ways that can be implemented to improve learners’ understanding of linear equations?

**1.6 Assumption of the study**

* Pupils who are going to take part have similar abilities in class due to the influence of their family environment.
* Pupils are bound to make errors when solving linear equation and equations involving word problems
* When answering questionnaires, learners will be honest and will have high regard for the questions that they will answer truthfully and return the questionnaire
* Increased interaction between the researcher and the learners will not affect the learner’s behaviour during the study which will in turn affect the overall results of the research  Pupils interact well if they are in groups.

**1.7 Significance of the study**

Linear algebraic equations are very crucial in a learner’s comprehension of scientific information as a whole; hence ability to solve them is of greatest important. If the researcher is able to find out problems affecting learners and suggest applicable solutions, this could go a long way in improving learner’s participation and performance in science in general. Teachers could help their learners to overcome both attitude and skill related problems that hinder their understanding of linear equations, hence learners will be able to solve questions in chemistry including SI notation.

The results of the study will help mathematics teachers at Globe Phoenix to come up with appropriate methods of simplifying linear equations and solving equations with word problems. Since this study focused only on a single school, there is need for further research in other schools, towns and countries, therefore, the results of this research could work to stimulate further research by others and it could serve as a basis for comparative studies in the area of mathematics. Only after those further studies are made, generalisations about O level learners as a whole, and this in turn would help policy makers, teacher educator as well as curriculum development unit in developing policies and curricular that enhances learners understanding of solving linear equations and mathematics as a whole.

* 1. **Limitations of the study**

The school schedule is tight, packed with other activities and other subjects. Learners are also expected to finish the syllabus in the two-year O level course, hence they a few free periods that the researcher can use for the study. Learners may also be reluctant to spend their free time confined in the class doing extra work in mathematics; therefore, this may affect their attitude and overall outcome of the study. Due to time limitations, the researcher could not get time to carry out interviews which produces detailed results rather than questionnaires. Questionnaires will be used to identify learners’ attitudes towards algebraic linear equations. However, people in general tend to take questionnaires for granted, ticking on responses without clearly understanding, or they may even ignore them, both of which has a great impact on the final results of this research.

* 1. **Delimitations of the study**

Learners throughout Zimbabwe, learners at various levels of secondary education face challenges in solving linear equations. However, for the purpose of this study, only learners doing Mathematics in Form 3 at just one school, Globe Phoenix high school in Kwekwe will be studied. Linear equations outlined in the New General Mathematics book will be used. There are a variety of sources of questions on linear equations that a teacher may use, including text books and other examination boards such as ZIMSCEC and Cambridge, however, for the purpose of this study, only questions available in the ZIMSEC past exam papers and New General Mathematics alone will be used to test learners.

* 1. **Definition of key terms**

**Challenges:** This can be seen as an obstacle that is hindering the effectiveness of a thing.

**Linear equation**:according to Malloy (2008) linear equation is an equation in which variables appear as separate terms and neither variable contains an exponent other than one **Solving:** Find an answer to, explanation for or a way of dealing with a problem.

**Constructivism**: the building of knowledge from previous knowledge structures according to Sriraman (2007)

* 1. **Conclusion**

This chapter has presented the different descriptions of mathematics, mathematics learning, its achievement, difficulty and students’ attitude to mathematics in general also the researcher focused on the background of the study, statement of the problem, research questions, research objectives, assumptions, and significance of the study, theoretical framework limitations, delimitations and definition of key terms. The next chapter will look into the literature review.

**CHAPTER 2: LITERATURE REVIEW**

* 1. **Chapter Introduction**

The chapter identifies the difficulties in learning mathematics and the possible solutions that had been proffered by other researchers. The chapter further presents the research gap that the study sought to bridge and add to the body of knowledge. The chapter will also look at the historical perspective and major concepts in linear equations. The chapter suggested some teaching methods that can be used for effective teaching of mathematics. The challenges faced by learners when solving linear equations, as well as measures suggested by different scholars and sources in the light of the research questions.

* 1. **Theoretical frame work**

An important aspect of solving linear equations involves having both procedural and conceptual understanding of the abstract. Kilpatrick etal (2001) emphasized that procedural skills must be accompanied by conceptual understanding. as students learn mathematics, they need to do more than just compute they need to understand the meaning and purpose of computations. Siegler (2003) discussed pitfalls in mathematics learning that develop as students focus on procedures rather than concepts, even students who do well in algebra classes often do so by treating the equations as exercises in symbol manipulation without any connection to real world contexts.

Constructivist advocate for active learning, which allows students to build their own conceptual understanding Ernest (1996) alludes that it is clear that learning is not about accumulating random information, memorizing it and then repeating it on some exam, learning is about understanding and applying concepts, constructing meaning and thinking about ideas. According to Gordon (2009) application of concepts and construction of meaning evidence conceptual understanding on the part of the students. Many cognitive scientists operate under the constructivist paradigms which advocates student strategy selection, cognitive scientist expects students to develop most efficient strategies and increase understanding through this selection process. The constructivists paradigm supports the use of manipulatives because learning is active and student functioning at concrete developmental levels benefit from the concrete aspect of manipulatives.

Procedural and conceptual understanding is an important component of constructivism and cognitive science students make connections and develop understandings not just memorize a set of facts or procedures. Star (2005) suggested that there are a limited number of procedures necessary for solving equations for this reason, conceptual understanding may be more important as students solve linear equations. If student understand the concepts such as the meaning of the equal sign, inverse operations and the role of constants and coefficients they may be able to use this conceptual understanding to accurately implement correct procedures while solving linear equations

* 1. **Historical perspective of linear algebra**

As the historical development of algebra revealed, variable was first used to represent unknownquantities and then to represent both givenand unknown. In school algebra, the variable usually means something with multiple or varying value, which is a little different from an unknown in that the unknown is usually a fixed value but humans do not know what it is. In school algebra, Weinberg (2005) maintained that to understand variable as a processusually means to substitute it with a specific value; for example, students tend to refer to a specific number when they use variables to represent a relationship. To understand a variable as an objectis to understand it as a placeholder or a given number. In this study, Weinberg’s understanding of variable as objector processwill be used. Another standard about students’ understanding of variable as objectis to see whether students can operate on or with variables. That is, if students can understand the variable as an object, they should be able to operate on or with it. The variable becomes the object of reflection or operation at a higher level by students. Students who understand variable as a processare usually uncomfortable or unable to operate with or on variables. For example, they may simplify an algebraic expression “T+1” into “T1”. They do not think that “T+1” is an acceptable or final answer.

* 1. **Mathematics learning: Constructivist perspective**

A number of studies have shown the effectiveness of the constructivist approach in teaching and learning in contrast to the traditional drilling and reciting approach in teaching. Piaget and Vygotsky are the pioneers of constructivism. According to Jean Piaget constructivism is a dynamic and interactive conception of learning in which all knowledge is constructed and it is a product of the cognitive acts of individuals. Chomsky (1968) points out that knowledge may be constructed by innate cognitive structures or by the results of developmental construction.

Simon (1995) advocates that learning occurs when learner’s conceptions are challenged by more complex situation, different contexts or information. Overcoming obstacles therefore is a central part of conceptual development. Constructivism does not specify a particular model of instruction, the construction of knowledge proceeds whether or not a teacher is present.

According to (Vygotsky 1986 p.206) the curriculum must not only focus on big ideas but it must also provide an environment and opportunities for learners to learn and employ the various cognitive processes that facilitate investigation and exploration. An investigative approach enables students to actively construct knowledge about the concept, skills and strategies related to the big idea. Several educators have explored the implications of constructivism on various models of instruction. Steffe (2010) identified three global periods in the teaching and learning process (1) constructive period meaning that learners come to grips with the nature of the problem or present it in different ways e.g., symbolically or through modelling identify the given and other information that is needed, devise a plan for solving the problem and verify the solution in the context of the problem. (2) Period of retroactive thematization meaning that the teacher will be mentoring, learners review the solutions to several related problems, examining their representations and solution strategies in order to identify common element. and (3) period of assimilating generalization meaning that during this period the concept is reconstructed as learners apply it to new, more complex problems, these new problems, contexts and solution strategies are identified and contribute to the robustness of the concept.

One way to teach for understanding is to avoid isolated facts and instead focus on the big ideas in mathematics that have application in many disciplines and relate them to the experiences relevant to the learner at his or her particular stage of cognitive development. A major goal of mathematics education is for students to realize and appreciate that mathematics is not only a powerful tool for understanding the world but it is also a powerful tool to discover the world. Silver (2009) advocates that understanding and discovering that is facilitated by curriculum that has a strong component of exploration, investigation and is problem based with such a curriculum students learn important mathematical concepts ,skills strategies as they deal with problems that may come from mathematics .Problems are not solved by simply applying one computational procedure .Rather they may require the application of a variety of mathematical concepts, skills and strategies for their solutions because of the complexity of the problems ,the solution may not be immediately nor easily determined.

Constructivist’s view classrooms as places where the teacher shows the learners procedures for getting the right answers and then monitors them as they reproduce those procedures. Schifter (1996) &Confrey (1990) suggest that three key assumptions about such direct instruction when related to mathematics are homework, assignments and test items accepted as providing adequate assessment of the success of instruction. Brooks & Brooks (1993) believes that learners either interpret what they see as it conforms to a prior set of rules or they generate new rules that fit what is perceived. From a cognitive perspective learning is flawed, the message that is received may not be the one sent. The leaners think they are right until they apply it and it does not work then they are confused. Chaulk (2007) points out that knowledge can be transferred but it must be constructed by each learner and it is only by articulating that knowledge will errors and misconceptions be identified.

Constructivists view that conceptual knowledge cannot be transferred ready made from the teacher to the learners but it must be built up by every learner solely on the basis of actual experience with reflection and meaningful conversations important parts of the learning process Steffe (2010). Richards (1991.p38) advocates that student will not become active learners by accident but by design through the use of plans that we structure to guide explorations and inquiry by learners. Vygotsky explores that some adaptation will require the use of different materials of explorations like computer presentation modifying the instructional structure by designing small groups to work on their own. In addition, for a classroom to be full of laughter, motivation, imagination, attention creativity and joy is a great achievement for a teacher and learners and also the organization and arrangement of the classroom.

Teachers are the architects of the classroom environment that will provoke learners curiosity about a phenomena .The teacher must have collection of problems of varying levels of complexity and must decide if the students have good background to have a good chance of solving the problem either alone or with more capable peers Latha (2007)states that the main cognitive abilities of learning that might cause learners difficulties in mathematics was the ability to memorize and recalling the facts which are related to making connection in their thinking in addition to that Stendall (2009) further explains that the ability to give good concentration ,to make meaningful perceptions to think logically and use memory effectively are important factors in solving problems and teachers must understand their leaner’s difficulties in order to create meaningful learning based on students intellectual needs. Polya (2002) was of opinion that classroom knowledge moves from teacher to student, student to student and from student to teacher.

Vygotsky believed in the primacy of culture shaping development. Its view of instruction was that interaction with adults or more advanced peers was necessary for development and that this required the active involvement of all participants. He assumed that the teacher can intentionally nurture and teach children only in collaboration with them and that process requires the teacher to move ahead of the development into what he called the Zone Proximal Development. Cobb (2010) proposed major goals in mathematics teaching through constructivist approach (1) learners should develop their mathematical structure that a more complex abstract than the ones they currently pose (2) learners should become autonomous and self-motivated in their mathematical activity (3) assessment, measurement and evaluation is what should be a natural part of the learning process. The theory of constructivism also values every learner, learners learn differently. The teacher as a facilitator, should appreciate every learner’s strength and weakness. Each learner should be given the opportunity to construct knowledge from their own experiences. The intent of the research conducted was to show that active learning strategies in the classroom would motivate and engage learners in the learning process, thus resulting in an enhanced understanding of mathematical concepts. Active learning strategies were suggested.

**2.4 Challenges faced by students when solving linear equations**

The challenges that pupils often encounter when solving equations are attributed to their inadequate understanding of the pre requisite knowledge. Van de Wale (2004) asserts that mathematics is hierachical in nature so learning of higher order concepts is successful only when related lower order concepts are fully grasped by the learners . he also posited that pupils need to make connections between the old and the new knowledge , they need to engage in reflective thinking sifting through existing ideas to find those that seem most useful in giving meaning to new concepts being learnt.

Raddatz (1979) classified the challenges in terms of (1) language difficulties. Mathematics is like a foreign language for students who need to know and understand mathematical concepts, symbols and vocabulary. misunderstanding the semantics of mathematics language may cause students errors at the biggening of the problem solving (2) difficulties in processing iconic and visual representation of mathematical knowledge for example grouping like terms together and manipulating signs and symbols (3) deficiency in requisite skills ,facts and concepts for example students may forget or be unable to recall related information in solving linear equations (4) incorrect association or rigid that is negative transfer caused by decoding and encoding information and (5)application of irrelevant rules or strategies

Other researchers Newman (1977), Watson (1980) have also used classifying method but based theirs on the model of problem-solving Watson used Newman s (1977) model of the sequence of steps in problem solving reading and comprehension, transformation, process skills and encoding to identify students’ major challenges. He thought that students’ challenges maybe due to deficiency in one or several of the above steps. in order to verify that hypothesis about students’ challenges, Watson designed both word and computation problems to compare the challenges made by two groups of students with lesser and greater abilities. He found that most initial challenges made by more able group were at the stage of reading and comprehension. However, the less able group student made many errors when applying and selecting mathematics processes. According to Ashlock (2002) not only categorized students challenges in computation and algebra.

Koji et al (2015) investigated the challenges faced by secondary school teachers and pupils in the teaching and learning of algebraic linear equations. A descriptive survey method was employed. Some identified challenges include: (i) lack of pre-requisite knowledge by pupils, (ii) lack of conceptual, procedural and strategic knowledge and skills required for solving linear equations and (iii) inappropriate approaches and methods used in the teaching of algebraic linear equations. He proposed that the teaching and learning of secondary school mathematics need to focus on transforming the quality land scape that has been identified especially the transition from arithmetic to algebra. Pupils need to be exposed to formulating equations from situations with which they are familiar and that teachers get regular refresher courses to keep them up-dated with new developments in the teaching and learning of mathematics. Thompson

(2020) Investigated on students’ difficulties in solving linear equation. This study used qualitative descriptive method. The result showed that and students have factual, conceptual, operational, and principal difficulties. Based on the result there is a need of meaningfulness teaching strategy to help students to overcome difficulties in solving linear equation problems. Lack of symbolic understanding of variables and coefficients within an equation Kilpatrick and Izasak (2008) According to Knuth (2006) lack of understanding of the meaning of the equal sign. Reliance on procedural knowledge without conceptual understanding Capraro (2006).

Therefore, it is clear that teachers need to help pupils acquire knowledge and skills in solving linear equations. Oliver (2010) conducted a qualitative study on challenges faced by leaners in solving linear equations. His findings were that inadequacy in pupils pre requisite knowledge was then measured using the explanatory variables pupil’s ability to formulate algebraic equations, pupils masterly of mathematical language for example translation and interpretation of word problems into symbolic algebraic conjectures as well as reading and interpreting symbolic and linear algebraic statement and manipulation of linear equations. These findings by previous researches are not unique to previous studies but also apply to the present study. On this research the researcher focuses on investigating challenges faced by learners in solving linear equations at Globe and Phoenix secondary school.

**2.5 What are the possible ways that can be implemented to improve learners’ understanding of linear equations**?

**2.5.1 Group work**

The Form 2 background also impacts on the mathematics teacher on how he can gain knowledge of what mode of instruction to use for learners to learn mathematics. William (1998) highlights the importance of mathematics teachers to base their mode of instruction in group work and through knowledge of student’s background if it is to be effective. In a study undertaken by UNICEF (2002) with aim to find out the effective teaching methods used by teachers in nine secondary schools in Zimbabwe which recorded 90 to 100 % pass rates in ZIMSEC examinations group work was rated number one teaching method. Mathematics teachers in this study were found to be very good facilitators and encouraged group work in solving mathematics problems. The same study also revealed that 70% of the schools send their students on various organized mathematics workshops and seminars.

The use of group work supports peer interaction which in turn led to more critical thinking however the effectiveness of group work depends on the learner’s mathematical knowledge and their experiences in co-operative setting as well as the teacher’s instructional goals Good et.al (1989) According to Crawford and Witte (2017) small groups or peer groups allow learners to ask questions without feeling threatened or embarrassed ,at times they are more willing to explain their understanding of concepts of problem solving approach by listening to other learners would be able to re-evaluate and re formulate ideas to form their own sense of understanding.

It is not exception to hear most student complain of their mathematics teachers failing to express or deliver of mode of instruction as the case with mathematical expressions, Farley (2002) explores that whilst they could be several problems behind this which may be overcome ed if teachers realized that through the use of group work, student can teach each other in a language they understand. Mahembe (2000), however argues that in such circumstances teachers should first realize that group work only works when they are one or two intellectually competent student in a group who can be used to help another student.

The difficulty with complex mathematical concepts such as linear equations are pointed out in Kuckerk (2010), that they do not only demand the competence of the mathematics teacher to teach them but demand effective use of teaching aids much as group work to achieve more. Mahembe (2000) note that they are many competent and experienced mathematics teachers in most schools, yet in their classes there is an equal percentage rate of failure as is that of passing. Mahembe also argues that in such circumstances mathematics teachers need to understand the dynamics of using group work and other effective teaching strategies to raise not only theirs but even students’ performance. This also applies to mathematics teachers at school under study where group work is used extensively in the mathematics department.

Ballard and King (1997) in their report findings suggested that group work was used successfully not only in the education field but even in manufacturing service delivery organizations to solve problems. The survey in which organization selected was based on the criteria that induce urban and rural mix covering groups such as mining, transport, construction and education. 70% of the survey participants reported greater achievement of goals through group work. Of interest to this were the views of the head of department at apprentice trained employees in the companies who contributed to use of group work as effective teaching strategy, it is of no doubt that group work can be used effectively in teaching of indices in schools especially at form 3. Farley (2002) brings out another dimension and advantages of group work as a teaching strategy. Group work is a powerful tool to help students solve problems at hand, to understand themselves and improves human relationships. In the mathematics case of indices and solving equations and indices through group interaction students learn to develop friends and communicate key attributes of getting work done, Mahembe (2000).

At a time when educational resources are at minimum, educationists and most mathematics teachers in the same district has mobilized untapped resources in the school. Robinson (1991) points out that these individuals become assistant facilitators, especially friends to help each other to deal with difficulties presented in mathematics problems such as indices and solving equation in indices. In groups they are taught the importance of skills regarding the nature of helping, confidentiality, acceptance understanding trust, worthiness and caring. Mathematics peer groups have proved particularly effective and preventing students from dropping mathematics at latter secondary stages. Further analysis of most peer groups as pointed out by Robinson (1991) shows a 99% success rate with most of the students taught through group work becoming successful in their chosen profession. Humans are richly endowed their potential for high achievement. Group work according to Boyce (2001) is a skill and process developed to assist people in improving the quality lives and maximize their potentials. Applied skilfully, with imaginary and intelligent by a competent caring person the group work method when used as a teaching aid can assist the group in achieving the mutually determined goals, achieving desirable change for students, experiencing personal, and family and adjustment problems. This is in the case of form 1 student’s in developing self enhancement and individual enrichment.

**2.5.2 Problem solving method**

According to Geary (2004) the achievement in problem solving is based on conceptual understanding and procedural knowledge. It cannot be denied that problem solving is an important part of mathematics education. Mathematics in general is an important subject because of its practical role to a person and society as a whole, however before a student can successfully solve a problem, he or she has to pose good reading comprehension as well as analytic and computational skills. Ibrahim (1997) states that the main procedural steps in problem solving (1) transforming the problem into mathematical sentence (2) computation of the operational involved in the mathematical sentence Weindrop (2016) noted that problem solving is a process starting from the minute student is faced with the problem until the end when the problem is solved.

Garnett (1998); Nathan et al 2002 explores that incomplete mastery of a number of facts , weaknesses in computation ,inability to connect conceptual aspects of mathematics ,insufficiency to transfer knowledge ,difficulty to make meaningful connection among information ,incomplete mastery of mathematical terms ,incomplete understanding and visualizing the mathematical concept might result in difficulties .These could lead to making various errors and confusion in the process of problem solving . . Burn (2007) is of the opinion that assessment should focus on understanding student’s ideas, problem solving skills and learning reactions. A good assessment can improve learning in many ways, feedback on assignments is also a valuable part of the learning process. Feedback can assist learners in setting goals, taking responsibility for their learning and becoming more independent in learning.

Problem solving in mathematics and reading comprehension go hand in hand solving mathematics problems entails the student to apply two skills at the same time reading and computing ,it is a double edged sword Geary (2004) on vocabulary develop vocabulary before the beginning of the maths lesson ,provide an interesting and challenging vocabulary activities involving comprehension and problem solving .In comprehension substitute large numbers with easier numbers or restate the problem in simpler terms and use object representation and manipulative to visualize word problems .Steffe (2010) points out that to do mathematics is thus conjecture to test , to debate, and then to revise or replace poor ideas. The classroom becomes a problem posing and problem-solving environment in which developing an approach to thinking is more valued than memorizing indices and using them to get answers. McConnell (2008) argues that it is not enough for learners to learn mathematics only by solving tasks that require computations or memorizing concepts and operations. Learners should be able to solve problems that encourage and develop thinking and logic skills. Problem solving is a skill that is required by life in general.

Game like activities can be used to help pupils to improve their vocabulary in mathematics. Teachers should use a variety of different techniques when teaching vocabulary Covington (2013) Von Hoff Johnson and Schlichting (2004) state that education games are ideal for engaging students in motivating activities, games may be used to improve and maintain understanding of essential vocabulary and to make learning mathematical vocabulary fun and more appealing to students e.g., in algebra and in geometry. According to Charlton et al (2005) the playful learning opportunities may be both interesting and motivational

**2.5.3 Discussion method**

It is a teaching strategy in which the teacher brings students face to face as they engage in verbal interchange of ideas. The teacher in his interactions with his learners performs a variety of roles. The teacher plays the role of a manager, referee, initiator or summarizer, the discussion method provides opportunity for discussion between the teacher and the students and also students to students it is centred on shared conversation and exchange of ideas in class. In other words, students in discussion class are not passive listeners neither the teacher a sole performer. Students are allowed to think critically and support his or her view logically Johnson, Johnson and Holube (1991) had affirmed that such cooperative spirit in learning help learners to work together to complete a task successfully and it promotes students’ independence.

Discussion strategy encourages cooperative team work between the students and the teacher, high, average and low archivers tend to benefit from cooperative learning and team work. Discussion emphasizes learners individually and group accountability with the teacher giving feedback. Johnson (1991) also suggested that interactions in the classroom promote cooperative learning and it is a successful strategy for reducing stereo typing and social rejection across disability, race and gender, all see themselves as members of a group as they participate in discussions listen to each other resolve differences make suggestions and critically think on how to come up with solutions. The ideas of suggested helped the researcher in coming up with some of the teaching strategies that might help to minimize errors and creating a good relationship between the teacher and the learners.

**2.6 Related studies**

According to Farrant (1984) teachers should be able to create connection and good relationship with the learners. The teacher should create a conducive environment and a good relationship as a method of educating so that whatever taught is mastered. Moreover Farrant (1984) states that a misbehaviour such as whispering passing notes during the lesson is not good, maintain discipline controlling undesirable behaviour. Farrant ‘s view is that a classroom practitioner should control pupils, for errors to be reduced concentration is important. Demonstration method is another method which is best for reducing errors as well as learner centred method where learners will be more involved in the learning.

The researcher can outline areas that pupils are likely to commit errors. Through good demonstration learners will be aware of errors thereby guarding against them Gwarinda (1993) states that the demonstrations involve direction and action by both the teacher and pupils. Gwarinda also states that the discussion method is the method of teaching whereby instead of the teacher doing all the talking the pupils do most of the talking in the guided manner. In this view, it can be observed that the researcher can involve pupils to talk introducing group work. Ross et al, (2002) noted that the mathematics reform challenges, the drill practice approach of mathematics lessons and present a more interactive classroom where mathematics is seen as a creative process involving extending, inventing, reflection and debating. Shifter (1996) stresses out that there is also an emphasis to stress student learning and growth instead of whether they have answered questions as right or wrong.

Different research findings have shown that the development of mathematical vocabulary affects learner’s solving different concepts in mathematics. According to Blessman (2001) one main cause of confusion in mathematics is vocabulary learners need stronger understanding of mathematical vocabulary to be successful in mathematics. Amen (2007) believes that understanding of mathematical vocabulary influences the comprehension of lessons tasks and various tests especially in solving word problems, so lack of understanding of mathematical terms affects capabilities to solve problems. Seasoned educationist takes use of group work as an effective teaching strategy.

Kent( 2002) advocates that most form 3 learners do not realize that mathematics can be made simple as they have faced challenges at ZJC .Ineffective use of teaching aids may negatively impact their understanding of mathematics .Most form 3 learners compulsorily study mathematics .Those at the other esteem who say they have difficulties in adding and subtracting will find it challenging to do mathematics ,understanding the experimental back ground of ZJC it affects learners both positively and negatively at ordinary level . According to Dawkins (2006) only like terms can be added or subtracted. We cannot obtain a single term by usingby-using law number one when solving a number with a negative power for example pupils should multiply and divide like terms only to minimize errors, moreover Dawkins (2006) further explains that when removing brackets multiply each term in brackets by the term outside the brackets. Channon et al (2000) states that just as arithmetic fractions in algebraic form must have a common denominator before they can be added or subtracted. Learners should be aware and treat equations in indices as algebraic expressions giving the common base so as to minimize the error of solving directly which is not necessary

Furthermore, Channon et al (2000) states that first evaluate the contents of brackets then do the multiplication or division before addition or subtraction. Rules of precedence must be followed to minimize errors. Learners may apply BODMAS. Channon et al (2000) also advocates that those terms should be grouped. It is the best way of simplifying linear equations. Sometimes when solving linear equations are grouped it is easier for pupils to completely simplify terms. This stops errors of them not grouping terms for further simplification. To avoid improper cancellation, any quantity to be cancelled must be a common factor to entire numerator and denominator. Bolt (1984) further explains that if the signs are the same the product is positive and if opposite the product is negative. Those who apply operating errors through this can be aware of signs and produce accurate answers http:// www venderbitt.edu states that to minimize errors the leaners should avoid shyness and ask question. The teacher should avoid hostility towards learners and learners should avoid bad vague handwriting. [http://www.alyso.org](http://www.alyso.org/) suggests that anything we can do to reduce errors by even the smallest degree is worth doing. The more errors are minimized by the better and the best way of eliminating them. Moreover [http://maths.com](http://maths.com/) states that provide time for your students to carefully analyse their errors to learn from their previous mistakes this again helps minimize errors.

**2.7 CHAPTER SUMMARY**

There are various studies undertaken and views by several writers on the topic of challenges faced, and ways to overcome those challenges in solving indices. The study looked at historical background of indices, the major concepts, the constructivist’s perspective, other teaching strategies and related literature. The view by constructivists is that knowledge is constructed and it is a product of cognitive acts for individuals. Learners should discover new ideas and should learn even in the absence of the teacher. And teacher must create an environment of learning that provoke learner’s curiosity to discover new ideas. Learners should discover new ideas through the use of the teaching strategies like group work, discussion and problem solving. Understanding the mathematics vocabulary involving comprehension also is very important in the learning of mathematics. The research also looked at the use of some suggested teaching strategies that may promote effective mathematics learning which are group work, problem solving and discussion method. The research went on to look at other researches that were done on challenges faced by learners and their proposed solutions. In the next chapter the researcher looked at how she managed to collect data. Instruments used and how data was represented, and the analysis plan used. The researcher observed that the way the topic is delivered determines the future pass rate.

**CHAPTER THREE: RESEARCH METHODOLOGY**

**3.0 Introduction**

In this chapter the researcher is going to discuss the research design, population, the research instruments and data collection procedures, as well as the merits and demerits encountered by the researcher whilst using each of those instruments. The methods used by the researcher in the study were clarified on how she found answers to the specific problems. Measures of condition for collections and exploration of data was the particular group which was involved in this study and how there were selected

**3.1 Ethical Considerations**

Ethics is an area never to be ignored. During the research some students interviewed could not disclose the information that was needed because they have tendency of not tolerating strangers. Some of the students and persons interviewed passed out biased information as they never took the questions too seriously and it was clear that they were hiding some truth.

**3.2 Research design**

The researchers’ study area is in Kwekwe District which falls under Midlands Province in Zimbabwe. The study was conducted at Globe and Phoenix Secondary School. A qualitative research design was adopted by the researcher. According to Robson (1993:19) research design is a systematic plan to study a scientific problem. Schvaneveldt (1991) also define a research design as plans that guide decisions as to when and how to collect the data, from whom and how to analyse the data. Robson, (1993) further points out that a research design also refers to the types of study which include cross-sectional studies, time series analysis, case studies and experimental designs. MacMillan *et al* (1989) define a research design as a plan or structure for an investigation. It is a set of plans and procedures which should be systematically and methodologically followed to achieve set or prescribed goals.

This researcher adopted the qualitative design to gather teacher’s opinions, facts, attitudes and history on teaching linear equation. The study was cross sectional (once off) to the sampled teachers. Researchers do not focus on the discovery of collective generable truth nor do they typically look at causative influence of the relationship, instead emphasis is on investigation and description. A case study is also known as a case report and employs an extensive analysis of an individual unit. Bell (1999) goes on to say that a case study stresses development factors that are commonly used in social sciences. The case study was intended to answer in most cases the how and what questions which are quite significant in this study. The distinctive need for a case study arises out of the desire to understand the challenges faced by form three leaners when solving linear equations at Globe and Phoenix Secondary School. The research design constitutes qualitative research that was used to collect data. The researcher chooses the cumulative study approach because it aggregates information from several sites collected at different times. It increases levels of authenticity. It is also useful for testing whether scientific theories and models actually work in the real world. O’ neil (2002) supports this view when he defines the case study as an empirical inquiry that investigates a contemporary phenomenon within its real-life context when the boundary between phenomenon and context are not clearly evident and in which multiple sources if evidence is used. Oppenheim (1992), says when one conducts research, focus must be put on the targeted population which is representative of variables under study.

**3.3 Sampling**

Non probability sampling was used by the researcher. Purposive sampling was adopted so gather data about linear equation from the four mathematics teachers at Globe and Phoenix secondary school. A research population is a well-defined collection of individual or objects known to have similar characteristics in common that are of interest to the researcher. Other scholars refer to a population generally as large collection of individuals or objects that is the main focus of the scientific enquiry.

**3.4 Research instruments**

Semi structured interviews and in class observations were conducted. The researcher made tenday observations as the maths teachers conducted lessons. The interview guides helped he researcher to ask questions to each teacher as notes were taken note of. The notes were them analysed into common theses and quotes as presented in chapter four. The mark books were used to record linear equation and other subjects’ marks during class tests and revisions. The scoring range helped the researcher to ascertain how pupils were performing across the different maths lessons or topics.

Data was generated through semi structured interviews in an attempt to understand the discourse on the impacts of mathematics .Interviews were one way to obtain information about personal feelings ,perceptions and opinions through interactive talking and discussions as to gather facts from which to construct the research arguments .Semi structured interviews provided participants with some guidance on what to talk about which was quite helpful n’ the flexibility of this approach compared to structured interviews that it allowed for the discovery or elaboration of information that was important to participants but which the researcher had not even anticipated before the interviews Graziano and Raulin (2000),argue that semi structured interviews may yield much more than those that are fully structured interviews are useful when dealing with sensitive topics which people may feel uncomfortable discussing in a focus group.

All interviews were conducted in a conservational form referred to as informal conservational or the interactive relational approach. The researcher used this approach because it is spontaneous and serendipitous (Patton, 2002). Burney (1994) points out that the effectiveness of the interactive relational approach is that it does not ignore the dynamics between the interview and the interviewee. His argument is that it is possible to access information that would not emerge through formal and structured questioning alone. Such an approach is very necessary in interviews which look at sensitive issues and, in this case, challenges faced by form 3 learners in solving linear equations.

Interviews yield a lot of information quickly through dialogue. Another advantage noted by the researcher was that information was immediately collected and there was immediate follow up and clarification of data. The researcher could understand meanings through a combination of all senses looking, hearing, smelling and touching. The interview targeted three teachers in Kwekwe District. However, schedule will have 5 questions which shall allow the researcher to probe further where the information given by the questionnaires would be limited. The main advantages of interview would be its flexibility. The predominant form of data collection is formal interview specifically face to face, verbal interaction which accounts respondents. The researcher used interview schedule to obtain information from teachers. The interview method showed its major advantage by allowing the researcher to observe nonverbal behaviour and to probe interviewees for clarification on answers and responses. Body language like frowns were noticed and the researcher assumed that it showed that the interviewee was thinking of what to say. face to face helped the interviewee to get the desired results and help her with the expression of the person to whom they were interviewing.

The researcher so it suitable to use observation as a data collection tool for the first-hand information as well as to ensure authenticity of the data gathered ‘Stenhouse (1975) defines observation as a systematic inquiry made public. Humans are very well equipped to pick up detailed information about their environment through their senses. Geertz (1973) suggests that observation can provide qualitative data sometimes described as thick description. The researcher used covert observation which is a type of observation where the researcher does not identify themselves, either they mix in with subjects undetected or they observe from a distance. The researcher had to access the area through attending the lessons. It was also during the schooldays which enabled the researcher to take note of the area as to help compare her evidence with the information from the interview guides and questionnaires. Dewalt (2001) notes that focused observation goes beyond just hanging out. Plan and reflexive observer use observation systematically. Therefore, it was crucial for the researcher to record what she was observing

Document analysis was used. according to Patton (1990) document analysis is an important aspect of data collection which yields extracts, quotations, or outline passages from organizational program records, memoranda and correspondence, official publications, reports and surveys. The following documents were analysed schemes of work, assessment and evaluation e.g. Test designing and marking, remedial and extension work, textbooks, student’s exercise books bearing in mind that data appearing in print are not trustworthy and making efforts to establish trustworthiness through triangulation.

**3.5 Data presentation and analysis procedures**

Thematic analysis was used to analysed the qualitative data. Michel (2001) defines data analysis as a process of inspecting, cleaning, transforming and modelling data with the goal of highlighting useful information, suggesting conclusions and supporting decision making. The researcher made the information comprehensive for the reader by analysing data using graphs and tables. Data presentation and analysis enabled the researcher to discover the patterns, themes new ideas and in general to have a better understanding of the topic under study. The researcher distributed questionnaires to forty respondents (40learners) for the study and interviewed three teachers. The respondents showed no problem in understanding the questions. After completion of the questionnaires and interview guides, item responses were created to score items. The results together with data collected from the interviews will be presented on tables’ pie charts, bar graphs. The researcher used the methods that helped to clarify data and to draw conclusions on data presentation the researcher would compare the responses obtained from three instruments. The researcher would make conclusions and recommendations to questions. The gathered information would be analysed in relation to the research questions.

**3.6 Chapter Summary**

This chapter concentrated on the research design, population and sample. It also dealt with data collection tools highlighting their strengths and limitations as well as the designing of these tools. The descriptive research design was chosen due to its ability to allow research to be undertaken in a relatively new area of study to the researcher. Data collection instruments used were interviews and questionnaires. The use of these tools in collecting data was meant to produce quality reliable results. The chapter also considered some ethical considerations that were observed during data collection. An analysis of the collected data will be done in the following chapter 4. The next chapter holds the analysis, interpretations and discussions on study findings so as to come up with recommendations

**CHAPTER 4: DATA PRESENTATION, INTERPRETATION AND ANALYSIS**

**4.0 Introduction**

This chapter focuses on the results of the study. The researcher presented, analyzed and interpreted the data collected from Globe and Phoenix Secondary School using interviews and document analysis. Thematic analysis was administered to the collected data. Interpretations and summarization of each presentation done was taken into consideration in this chapter.

**4.1 Do most form 3 learners comprehend the linear equations?**

**Respondent 1** most pupils fail to comprehend linear equations especially word problems, because they fail to understand the comprehension. This was supported by Raddatz (1979) from the literature review. Some leaners may fail to give the correct answers because of lack of practice. **Respondent 2** shows that more than 50% of the learners fail to work out problems that involve the combination of different variable. they also fail to solve linear equations graphically; it also shows that learners fail to see the link between the two and this result in them facing many challenges when dealing with linear equations. **Respondent 3** learners fail to group like terms together for them solve the linear equations as supported by Dawkins (2006) from the literature review, they treat the variables the same then they add or subtract.

From the responses given the researcher observed that most learners fail to solve the equations appropriately especially if the equation contains too much information

**4.2 Which major challenges are by faced by form 3 learners when learning linear equations?**

Respondent 1 – learners may have careless errors where it may be as a result of not paying attention, working too fast, copying the problem wrong or computational errors where somewhere in the process they incorrectly added, subtracted, multiplied or divided. These findings were supported by Boyce (2001) from the literature review. Making one computational mistake in a multi-step problem means the rest of their working will be wrong and the final solution will be wrong. Respondent 2- careless errors and conceptual errors occurs because the leaners have misunderstood the underlying concepts or they have used incorrect logic.

**4.3 Do learners have attitude towards solving linear equations?**

**Respondent 1** learners have attitude towards linear equation especially drawing linear graphs using the linear equations most learners fail to substitute from the equation in order to find the (x, y) coordinates. **Respondent 2** learners have attitude towards linear equations especially when grouping the like terms together, they fail to treat the signs correctly for example when a number crosses the equal sign, they forget to the change the sign. **Respondent 3** some learners have attitude towards linear equations especially word problems. learner’s fail to interpret questions involving word problems because they lack to understanding of the jargon or vocabulary resultantly, they will have attitude towards word problems. **Respondent 4** leaners have attitude towards simultaneous equations. They fail to use substitution or elimination to solve the equations

**4.4 Which type in particular, expression or word problems**

1. Grouping like terms example ap – bq- a + bp
2. Solve the simultaneous equations example 2x-y = 4, 3x + y =11
3. A number of travelers were questioned about the transport they used on a particular day 6 said that they travelled by bus and train only ,2 by train and car only and 7 by bus, train and car. the number x who travelled by bus only was equal to the number who travelled by bus and car only. Given that 35 people used buses and 25 people used trains find (a) the value of x (b) the number who travelled by train only (c) the number who travelled by at least two methods of transport. given also that 85 people were questioned altogether calculate (d) the number who travelled by car only
   1. **What can be done to improve students understanding of linear equations**

**Respondent 1** I use the class discussion method because using it as a primary teaching method allows you to stimulate critical thinking. As you establish a rapport with the learners, you can demonstrate that you appreciate their contributions at the same time that you challenge them to think more deeply and to calculate their ideas more clearly. **Respondent 2** said there will be frequent questions, whether asked by him or by the learners provides a means of measuring learning and exploring in-depth the key concepts of the topic of linear equations. **Respondent 3** I prefer the demonstration method because it helps in involving various sense to make learning permanent. It helps in achieving psychomotor objectives and develops interest in the learners and motivates them for their active participation. **Respondent 4**- when I go to evaluate these two teachers, they will be using these two teachings methods in their classrooms. These findings are in line with the findings of Mutasa and Wills (1995:39) from the literature review who observe that the learner centered approach acknowledges the needs of children, their capabilities, and their level of comprehension, their experiences, their motivations and their natural propensity for learning. If teachers do not use the proper method of teaching linear equations, there will be low performances as the pupils would not understand the concept. Therefore, teachers should help pupils in this topic depending on the best teaching method so that they really understand. This is in line with the findings of Ho Kheong and Tan Hoo (1995) from the literature review that there are various methods used in simplifying linear equations. Allowing learners to use their own informal methods in simplifying linear equations will pave a way of creating alternative methods.

* 1. **Responses from the observations made by the researcher**

**Respondent 1**

A number of items focused on this aspect. These are the items: methodology, assessment and media. The purpose of these items is to seek information on what teachers regard as good teaching and practices that they engage in to help their learners develop understanding of taught concepts. Respondent 1 from day one up to day ten, he used the class discussion and a bit of demonstration as his methods of teaching. During the lessons using these methods these methods, he gave daily exercises since mathematics is a practical subject and he also gave one test towards the end of the chapter as well as remedial and extension work each and every day of his normal lessons. The methodologies he used was best way to teach equations and also to show learners how to work out solutions and let them practice the skill in groups, while on assessment more work was given in terms of daily exercises because mathematics is a practical subject so it needs to be written each and every day. Formative assessment was used to monitor learning progress during the observation by the researcher. Its purpose was to provide continuous feedback to both the student and the teacher in order to identify success and failures. This is supported by Gwarinda (1995) who concurs by saying that formative evaluation is the on-going process of evaluating or judging the process of the course or curriculum from time to time as the course proceeds. Group assignment and other types of assessment were used during observed lessons. Formative assessment can also include diagnostic testing so that areas of weaknesses among the learners are identified, thereafter remedial action is taken. The media used was appropriate for the lessons, but there is still need on remedial work and extension work.

**Respondent 2**

The researcher observed ten different lessons conducted by Teacher B. On the observation above, pupils are not given the opportunity to explore and discover the best methods on dealing with linear equations Pupils should be allowed to use their own method and procedures in simplifying linear equations. This is consistent with the findings of Ho Kheong and Tan Hoo (1995), from the literature review who observed that there are various methods used in simplifying linear equations. Allowing pupils to use their own informal methods in simplifying linear equations will pave a way creating alternative methods. Formative assessment was used by the teacher but based on daily exercises and the test. The researcher observed that demonstration and class discussion these are the best teaching methods in mathematics. According to the observations made, the respondent 2 should shift the teaching method into learner centered and also there is need of teaching media. If teachers do not use teaching aid such as number line, charts and bottle tops in the learning and teaching of linear equations, there might be low performances as the pupils would not understand the concept. Respondent 2 from day one, he used the demonstration method more with a little bit of class discussion as his methods of teaching. During these methods, she gave daily exercises and she also gave one test towards the end of the chapter as well as remedial and extension work each and every day of his normal lessons. The methodologies he used was best way to teach linear equations and also to show learners how to work out solutions and let them practice the skills in groups, while on assessment more work was given in terms of daily exercises because mathematics is a practical subject so it needs to be written each and every day

**4.7 discussion of the results**

It came out that the majority of pupils had challenges in solving word problems in linear equations. This was common because pupils would fail to comprehend the demands of the questions. Identifying the set variables is inherently difficult if the word set in not understood by the pupil.

It also came out that pupils fail to group the like terms together. One teacher noted that,

‘…. for instance, in the equation; 2x +2y+4=6x+2 a pupil may mistakenly add 2x+2y-

6x without noting the difference in X and Y variables.’

The results also show that in some circumstances pupils do not pay attention to the given questions and hastily respond. When the pupils rush through the questions they incorrectly add, subtract, multiply or divide. Making one computational mistake in a multi-step problem means the rest of their working will be wrong and the final solution will be wrong. Careless errors and conceptual errors occur because the leaners have misunderstood the underlying concepts or they have used incorrect logic. The headmistress after inspecting books of classes of these teachers identifies these types of errors done by learners in solving equations. The opined two examples show that pupils have challenges understanding equations which are wordy.

The interviewees were asked to share the teaching strategies they would implore to resolve the challenges that pupils face in calculating linear equations. Results showed that, the teachers used class discussions. Class discussions allow the teacher to stimulate critical thinking among pupils. In class discussions the quiet and shy pupils get space to speak out as others do. Class discussions trigger the pupils to speak amongst themselves and once they speak out challenges are resolved. Class discussions is a way of rapport building; the teacher can demonstrate that they appreciate the pupil’s contributions thus challenge them to think more deeply. In class discussions there are usually frequent questions and communication is two-way between the teacher and the learners. During the discussions, the pupils may ask other questions beyond just the subject area, thus learning become holistic.

It was observed during the in-class observations that the teachers gave daily exercises and one test at the end of the chapter. The learners would learn in groups thus sharing ideas and systematically following the formulars. After the teacher demonstrate the calculation, the pupils would work out solutions in groups. Formative assessment was used to monitor learning progress during the observation by the researcher. Its purpose was to provide continuous feedback to both the student and the teacher in order to identify success and failures. This affirm earlier findings by Gwarinda (1995) that formative evaluation is the on-going process of evaluating or judging the process of the course or curriculum from time to time as the course proceeds. Group assignment and other types of assessment were used during observed lessons. Formative assessment can also include diagnostic testing so that areas of weaknesses among the learners are identified, thereafter remedial action is taken. The media used was appropriate for the lessons, but there is still need on remedial work and extension work.

The demonstration method was also suggested as it involving various sense to make learning permanent. During demonstration senses and skills such as hearing (listening), seeing and practicing how to resolve the equations. When pupils follow through the calculations, comprehension is greatly improved as pupils can recalculate, during the lesson, at home or in other studies. Ultimately, the discussion method improves the psychomotor objectives and develops interest in the learners and motivates them for their active participation. These findings are in line with the findings of Mutasa and Wills (1995:39) from the literature review who observe that the learner centered approach acknowledges the needs of children, their capabilities, and their level of comprehension, their experiences, their motivations and their natural propensity for learning. If teachers do not use the proper method of teaching linear equations, there will be low performances as the pupils would not understand the concept. Therefore, teachers should help pupils in this topic depending on the best teaching method so that they really understand.

**4.8 Chapter Summary**

In this chapter, an attempt has been made to analyze and interpret the findings of the investigation. The challenges faced by the learners include failure to understand the requirements of the questions, due to word challenges. It came out, teachers should be flexible to use mixed and holistic teaching methods to solve linear equations. The nature of media applied vary for each student and class. The suggested teaching strategies class discussions, problem solving and groupwork as teachers shifted from one media to the other the learner’s motivation was enhanced and understanding was improved. More practical solutions were undertaken to improve linear equations calculations. Chapter five will provide conclusion, and recommendation to other researchers who might want to take the similar investigation.

**Chapter 5: SUMMARY, CONCLUSIONS AND RECOMMENDATIONS**

**5.0 Introduction**

This chapter presents summary and conclusions basing on the data in chapter 4. In addition, the chapter also provides recommendations to future studies. This study aimed at finding the challenges encountered when solving linear equations at Form 3 in one of the schools KweKwe District schools.

**5.1 Conclusion**

It can be concluded that effective teaching and learning of linear equations requires teachers to vary teaching methodologies that help to simplify complex linear equations and also the direct involvement of the learners. Teachers also need to understand the challenges that pupils are facing before proffering solutions. The challenges include vocabulary, failing to group like terms, and use the signs correctly. Challenges resulting in students not comprehending the laidout questions. Daily exercises and tests written by learners have indicated that learners have challenges in solving linear equations. Failure to emphasize the basic algebraic equations really affects learners’ overall performances in different topics. Many challenges were highlighted which hinder the topic of linear equations at form 3 level mathematics. Possible solutions were suggested for example varying teaching methods to make learning simpler and interesting in order to motivate learners. The interview guides and observations are more appropriate to measure the correct level of mental constructions. Thus, the researcher can conclude that a combination of results of interviews and observations will give a better and clear picture of the understanding of challenges being faced by the Form 3 learners in solving linear equations

**5.2 Recommendations**

On the basis of the findings of the research, the researcher recommends:

-Programs and/or interventions supporting group work as a teaching strategy to effective learning of linear equations.

-Teachers should vary their teaching methods to enhance learners’ participation and performance during linear equation lessons.

-Teachers need to understand student’s problems and learning process in order to implement more effective and explicitly teaching strategies so as to provide meaningful learning in students.

-Mathematics teachers should let learners to discover for themselves problem solving techniques so as to facilitate logical reasoning and critical thinking because in constructivists perspective.

-It is important to encourage learners to gather their own media for use so as to cultivate moral aspect in them. Hence, they will feel accommodated in the learning process and build up intrinsic motivation which is crucial in the skill and concept acquisition process.

-Learners should find joy and fulfillment on the subject by exposing themselves to questions using different methods of solving as they are being taught as well as working in groups. The more they like or enjoy the subject, the more likely they are going to achieve good results.

**5.3 Areas for further investigation**

-A critical analysis of the errors in resolving linear equations

-A comparison of learning media used in rural and urban schools

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**APPENDIX B: RESEARCH INSTRUMENTS**

**Interview guide for teachers**

**Question 1**

Do most form 3 learners comprehend the linear equations?

**Question 2**

Which major challenges are faced by form 3 learners when learning linear equations?

**Question 3**

Do Leaners have attitude towards linear equations?

**Question 4**

Which type in particular, expression or word problems?

**Question 5**

What can be done to improve students’ understanding of linear equations?