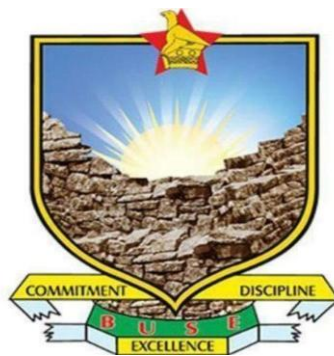




BINDURA UNIVERSITY OF SCIENCE EDUCATION

**TOPIC: EXPLORING TEACHING METHODS USED BY SECONDARY SCHOOL
TEACHERS WHEN TEACHING QUADRATIC EQUATIONS AT ORDINARY LEVEL.**

BY

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**A DISSERTATION SUBMITTED IN PARTIAL FULFILMENT OF THE
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MATHEMATICS.**

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The undersigned certify that they have supervised, read and recommended to Bindura

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Submittedin partial fulfillment of the requirement of the Bachelor of Science Education Honours Degree in Mathematics

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Thank you all.

DEDICATION

I dedicate this research to all the teachers and lecturers in the mathematics department in our country. I hope and trust that all those who will go through this research will be inspired by it.

ABSTRACT

The teaching strategies used by secondary school instructors to teach quadratic equations at the ordinary level are examined in this study. Qualitative data gathering and analysis techniques were combined in a mixed-methods approach. A sample of secondary school teachers was given a survey questionnaire, and respondents were interviewed further. The results show that teachers employ a variety of teaching strategies, such as completing the square, factorization, quadratic formula and lecture method. The study also highlights variables including student ability, time limits, and resource availability that affect teachers' technique choices. The findings' implications for teaching and learning quadratic equations at the ordinary level are examined, and suggestions are offered for curriculum design and teacher professional development.

Key words. Quadratic equations, Teaching methods

Contents

APPROVAL FORM	i
RELEASE FORM.....	iii
ACKNOWLEDGEMENTS	iv
DEDICATION	v
ABSTRACT.....	vi
RESEARCH TOPIC	1
CHAPTER 1: INTRODUCTION	1
1:2 Background of the Study:	2
1:3 Purpose of the study	3
1:4 Statement of the problem	3
1:5 Research questions.....	4
1:6 Research Objectives.....	4
1:7 Research assumptions	5
1:8 Significance of the study.....	5
Significance to teachers	5
To the Nation	6
1:9 Delimitations.....	6
1:10 Limitations	7
1:11 Definition of terms.....	7
Quadratic equations	7
1:12 Organization of the study.....	8
1:13 Chapter summary	10
CHAPTER 2	10
REVIEW OF RELATED LITERATURE	10
2.1 Introduction.....	10
2.2 Theoretical Framework.....	11
2.2.1 Constructivist teaching.....	11
2.2.2 Vygosky's Socio-Cultural Theory	13
2.3 Literature Review	13
2:3:1 Empirical studies	13

Research Gaps.....	15
Conclusion	16
CHAPTER 3	17
RESEARCH DESIGN AND METHODOLOGY	17
3.1 Introduction.....	17
3.2 Research paradigm.....	17
3.3 Research Approach	17
3.4 Research Design.....	18
3.5 Population	19
3.6 Sampling	19
3.7 Research instruments	20
3.7.1 Interviews.....	21
3.7.2 Open ended questionnaire.....	23
3.8 Validity and reliability	24
3.9 Pilot study	24
3.10 Triangulation.....	25
3.11 Data collection procedures.....	26
3.12 Data presentation and analysis.....	27
3.12 Ethical considerations	27
3.12.1 Informed consent	27
3.12.2 Non-maleficence	28
3.12.3 Confidentiality	28
3.13 Summary	29
CHAPTER 4. Data Presentation, Analysis and Discussion.....	29
4.1 Introduction:.....	29
Figure1	29
4.2 Most Employed Instructional Strategies	30
4.2.1 Straightforward Guidance	30
4.2.2 Learning via Problems.	30
4.2.3 Group Instruction	30
4.2.4 Integration of Technology.....	31
4.3 Difficulties Teachers Face	31

4.3.1 Varying Capabilities for Learning	31
Figure 2	31
4.3.2 Insufficient Assets	32
4.3.3 Limited Time	32
4.4 Techniques for Improving Knowledge	32
4.4.1 Methods of Scaffolding.....	32
4.4.2 Formative Evaluation.....	33
4.4.3 Applications in Real Life	33
4.4.4 Career Advancement.....	33
4.5 Conclusion	33
CHAPTER 5	34
SUMMARY, CONCLUSIONS AND RECOMMENDATIONS	34
5.1: Introduction.....	34
5.2 Summary	35
5.3 Conclusions.....	36
5:4 Recommendations.....	36
References.....	38
APPENDIX A.....	41
Questionnaire for teachers	41
APPENDIX B	48
INTERVIEW GUIDE	48

RESEARCH TOPIC

Exploring methods used by teachers when teaching quadratic equations at ordinary level.

CHAPTER 1: INTRODUCTION

1:1 Introduction

Quadratic equations are a fundamental concept in mathematics, essential for understanding various mathematical and scientific principles. However, research has consistently shown that many students struggle to comprehend and apply quadratic equations, leading to difficulties in advanced mathematics and science courses. Effective teaching of quadratic equations is crucial to overcome this challenge.

Secondary school teachers play a vital role in shaping students' understanding of quadratic equations. While some teachers successfully foster student understanding, others struggle to engage and motivate their students. The disparity in teaching methods and effectiveness raises questions about the approaches and strategies employed by secondary school teachers to teach quadratic equations.

This study aims to investigate the methods used by secondary school teachers to teach quadratic equations, exploring the range of pedagogical approaches, resources, and assessments employed. By examining the teaching practices and student learning outcomes, this research seeks to identify effective methods and strategies that enhance student understanding and achievement in quadratic equations. The findings will contribute to the development of evidence-based teaching practices, informing teacher professional development, curriculum design, and educational

policy. Ultimately, this research strives to improve student learning outcomes in mathematics and related fields.

1:2 Background of the Study:

Quadratic equations are a fundamental concept in mathematics, essential for understanding various mathematical and scientific principles (Didis & Erbas, 2015). However, research has consistently shown that many students struggle to comprehend and apply quadratic equations, leading to difficulties in advanced mathematics and science courses (Tendere & Mutambara, 2020).

Effective teaching of quadratic equations is crucial to overcome this challenge. Secondary school teachers play a vital role in shaping students' understanding of quadratic equations (Kabar & Gözde, 2018). While some teachers successfully foster student understanding, others struggle to engage and motivate their students (O'Connor & Norton, 2016). The disparity in teaching methods and effectiveness raises questions about the approaches and strategies employed by secondary school teachers to teach quadratic equations.

Therefore, exploring the methods used by secondary school teachers to teach quadratic equations can provide valuable insights into effective teaching practices, ultimately enhancing student learning outcomes in mathematics.

1:3 Purpose of the study

"The purpose of this study is to explore and document the methods and strategies used by secondary school teachers to teach quadratic equations, in order to:

- i. Identify effective teaching practices that enhance student understanding and achievement in quadratic equations.
- ii. Investigate the relationship between teacher pedagogy and student learning outcomes in quadratic equations.
- iii. Develop a framework for effective teaching of quadratic equations that can inform teacher professional development and curriculum design.

1:4 Statement of the problem

"Despite the importance of quadratic equations in mathematics and science, many secondary school students struggle to understand and apply these concepts, leading to poor performance and lack of confidence in mathematics. Research suggests that teacher pedagogy and content knowledge play a crucial role in student learning outcomes, yet there is limited understanding of the specific methods and strategies used by secondary school teachers to teach quadratic equations. This study aims to address this knowledge gap by exploring the methods used by secondary school teachers to teach quadratic equations, and investigating the impact of these methods on student learning outcomes. The findings of this study will provide valuable insights for teacher professional development, curriculum design, and educational policy, ultimately aiming to improve student achievement and confidence in mathematics."

1:5 Research questions

- i. What are the most commonly used teaching methods to teach quadratic equations at secondary school level?
- ii. What are the challenges faced by teachers when teaching quadratic equations at secondary school level?
- iii. How do secondary school teachers help students understand the quadratic equations concept?

1:6 Research Objectives

General objective

By the end of the research, the researcher should be able to:

Explore and investigate the methods and strategies used by secondary school teachers to teach quadratic equations, and to identify effective practices that enhance student understanding and achievement in this area of mathematics.

Specific objectives

By the end of the research, one should be able to:

- i. Identify the most common methods used by teachers to teach quadratic equations
- ii. Investigate the effectiveness of different teaching approaches on student learning outcome
- iii. Explore the relationship between teacher pedagogy and student understanding of quadratic equations
- iv. Identify challenges and barriers faced by teachers when teaching quadratic equations

1:7 Research assumptions

The researcher had the following assumptions:

- i. Teachers' beliefs and attitudes about mathematics and teaching will influence their approach to teaching quadratic equations.
- ii. Teachers' pedagogical content knowledge and skills in teaching quadratic equations will impact student learning outcomes.
- iii. Teachers will use a variety of teaching methods, including lecture, group work, and problem-solving activities, to teach quadratic equations.
- iv. Teachers' experience and qualifications will impact their effectiveness in teaching quadratic equations.

1:8 Significance of the study

Significance to teachers

By identifying effective teaching methods, this study can inform teacher professional development and curriculum design, ultimately enhancing student achievement and confidence in mathematics. The study's findings can help teachers refine their pedagogical approaches, leading to more effective teaching and learning.

Quadratic equations are a fundamental concept in mathematics, and this study aims to address the challenges students face in understanding and applying them.

To the Nation

The study's results can guide the development of mathematics curricula and educational policies that support effective teaching and learning. This study adds to the existing body of knowledge on teaching and learning mathematics, specifically in the area of algebraic equations.

By exploring the methods used by secondary school teachers to teach quadratic equations, this study has the potential to positively impact student learning outcomes, teacher pedagogy, and mathematics education as a whole.

1:9 Delimitations

Delimitation of the study refers to the boundaries intentionally imposed to focus on the research and define its scope. In this study the major delimitations were as follows:

- i. The study is limited to only five secondary school teachers excluding other teachers around the nation.
- ii. The research is based on the methods used by secondary school teachers' methods of teaching quadratic equations, excluding other math topics and levels of education.
- iii. The study is only limited to teachers specifically in five different schools and the results may not be generalized to other schools

1:10 Limitations

Limitation of the study refers to constraints and weaknesses that may impact the validity, reliability or the generalizability of the research findings. Limitations to the research were as follows:

- i. The results rely on self-reported data from teachers which may be subject to bias or inaccuracies
- ii. The study may not be generalized to all secondary school teachers or educational contexts.
- iii. The study may not explore the effectiveness or student outcomes of teaching methods.

The above noted delimitations and limitations should be considered when designing or conducting research. Research should address the challenges and make appropriate justifications and adaptation for the potential impact on the generalizability of the study.

1:11 Definition of terms

Quadratic equations

A quadratic equation is an equation that can be written in the form $ax^2 + bx + c = 0$, with $a \neq 0$, where a, b, c are coefficients of the equation and x is the variable. (Makhule Gozde Didis Kabar).

A quadratic equation can also be defined as a second degree polynomial of the form $ax^2 + bx + c = 0$ where a, b & c are constants.

Teaching Methods

Geofrey defines teaching method a process of conveying and skills used by a teacher in a classroom.it can also be defined as an organized way in which a teacher transmit or entertains the information.

1:12 Organization of the study

The study is divided into five chapters.

Chapter 1

Chapter 1 focuses on introductory information such as background of the study, statement of the problem and also highlights the research questions. Furthermore, the chapter focuses on the objectives of the study as well as the limitations and delimitations of the study. Moreover, the assumptions and the significance of the study to all stakeholders are outlined. In addition, the definition of terms key to the study are given. Finally, an organization of the study and a summary mark the end of chapter one.

Chapter 2

Chapter 2 focuses on the literature review. Initially the conceptual frameworks to be used are highlighted. The study employed constructivist and socio-cultural learning theories. Constructivist posits that learners construct their own understanding through active engagement with the material while socio cultural theory emphasizes the role of social interactions and cultural tools in shaping learning. A review of previous studies on methods used to teach quadratic equations in secondary schools is also done. The researcher considered various

scholarly views in an attempt to explain the concept.

Chapter 3

The third chapter explores aspects such as the research methodology which involve the research design, population, sampling procedure, and data gathering instruments, ethical considerations as well as reliability and validity of the study. The study used the qualitative paradigm which uses interviews. The researcher used the purposive sampling technique.

Chapter 4

7

Data presentation, analysis and discussion are dealt with in chapter four. The fourth chapter presents data narratively and also through the use of tables and graphs. Responses from teachers are analyzed in a thematic manner as the researcher reviewed data, made notes and sorted the data collected. In addition, the researcher attempted to analyze links and patterns of the data collected.

Chapter 5

Finally, the fifth chapter gives a summary, conclusions and recommendations. Conclusions are based on the research findings. After the conclusions are made, the recommendations are derived in a bid to solve the problem.

1:13 Chapter summary

The above chapter provides an introduction in the study on exploring methods used by teachers when teaching quadratic equations in secondary schools. An extensive background of the study was provided. Also, the statement of the problem as well as the objectives that guided the study were outlined. The research questions that needed to be answered by the current study were highlighted. The research also gives insight into the assumptions, limitations, delimitations and most importantly, the significance of the study to the community as a whole. Definitions of terms related to the study were given and an organization of the study concluded the chapter. The next chapter, chapter 2 focuses on literature review.

CHAPTER 2

REVIEW OF RELATED LITERATURE

2.1 Introduction

The purpose of this chapter is to review the relevant literature on the methods used by teachers when teaching quadratic equations in secondary schools. Globally there has been widespread research in the area of teaching of quadratic equations in secondary schools. The first part of this chapter looks at the theoretical frameworks which underpin this study. In this case, the underlying theories are Constructivists and Socio-cultural theory. The second part is concerned with review of related literature.

2.2 Theoretical Framework

The researcher selected Constructivist and the Socio-cultural theory by Vygotsky as the theoretical frameworks underpinning this study.

2.2.1 Constructivist teaching

Constructivism is “an approach to learning that holds that people actively construct or make their own knowledge and that reality is determined by the experiences of the learner” (Elliott et al., 2000). A celebrated idea in education, constructivism has been around for a long time.

Teaching math through constructivist methods allows students to deepen their knowledge beyond rote memorization, develop meaningful context to comprehend the content, and take command of the learning process as an active participant rather than a sit-and-get observer. Constructivist learning works and pays dividends on students' ability for their entire life.

There are three schools of constructivist teaching—cognitive constructivism, social constructivism, and radical constructivism. Despite the differences in these schools of thought, five core principles underlie them all.

Knowledge is constructed. Using our prior knowledge, we build new knowledge by drawing comparisons and making connections. In math this means we use foundational concepts to build the next one (e.g., we learn to add by counting and multiply by adding repeatedly).

To learn, students must be part of the process (e.g., problem-solving, productive struggle, debate, etc.) in order to understand new content; students can receive new information passively (e.g., being lectured to), but this pales in comparison to understanding it through direct, active participation.

We learn best by doing something together and interacting with it socially; our social behaviors and habits influence how we think about what we learn.

Knowledge is personal. Subjectivity of experience dictates that we each will differ in how we learn and comprehend a given concept. Received knowledge is both socially tempered and subjective in nature; as it is exclusively a process of the mind, we must agree that knowledge molds our perception of reality. As we learn more, we update our mental models of the world, thus changing how we see and interpret reality.

Teachers who take actions into consideration not only engage students with the content but tend to achieve higher academic results as well. This process takes time, though. “For significant learning, we need to revisit ideas, ponder them, try them out, play with them and use them” (Hein, 1991). It also takes motivation. Teachers, who create interpersonal connections with students, elicit their background knowledge, and tailor lessons to their interests are more successful constructivist teachers.

Teachers provide learning experiences for students through differentiated activities, including work with the teacher, group projects, and games. A teacher may also include a short mini-lesson to demonstrate a new technique or method of problem-solving. The teacher allows students to investigate, explore, and experience controlled failure in the classroom in order to learn, question, and embrace productive struggle. At no point should the teacher simply give students the answer and move on, assuming they understand the content. Instead, teachers celebrate the diversity of opinions, methods, and questions that arise from problem solving.

2.2.2 Vygotsky's Socio-Cultural Theory

According to Steele (2001), Vygotsky believed that the cultural development of child's word meaning is first processed on a social level and subsequently on an individual level (Steele, 2001; Vygotsky, 1962). Steele (2001) states that Lev Vygotsky understood that students possess some mathematical language; however, students' mathematical understanding is created when they are better able to connect new mathematical terminology with previous learning experiences. This belief moreover suggested that word meanings cannot be directly taught from one student to another because neither students nor teachers can successfully provide their own constructed understanding to another person (Sierpinska, 1998; Steele, 2001).

2:3 Literature Review

In this section the researcher will delve into the opinions of other researchers who have carried out prior studies on methods used by teachers when teaching quadratic equations in secondary schools. This will assist in the better understanding of methods used when teaching quadratic equations in secondary schools.

2:3:1 Empirical studies

Various studies have investigated the same topic on exploring teaching methods used by secondary school teachers when teaching ordinary level. All the studies done use different research designs. The researcher here is going to look at three journals by different authors

2:3:2 Author: Richeal Phil Thien Kim How , Hutkemri Zulnaidi , Suzieleez Syrene Abdul Rahim

Title: HOTS in Quadratic Equations: Teaching Style Preferences and Challenges Faced by Malaysian Teachers.

Journal: European journal of science and mathematics education

Methodology: Qualitative approaches via face to face interviews were conducted at the participants' schools.

Data Collection: the researcher used snowball sampling technique with four teachers from the district.

Data Analysis: data was analysed using ATLAS.ti 8 software. Thematic analysis was conducted using the ATLAS.ti8 software.

Results: three themes have emerged from the analysis of the research questions.

Author: Moses Chirimbana, Kenneth Nzwala, Musokotwani Sezuni Martin

Title: Examining the Methods Used by Math Teachers in the Zambezi Region of Namibia to Address Algebra Problems Faced by Grade Twelve Learners

Journal: Open journal of social sciences

Methodology: the researcher used descriptive qualitative research design in observing and describing everyday practices of specific events of mathematics teachers' strategies in teaching.

Data Collection: the researcher used a sample of twelve teachers teaching algebra. Interviews observational schedules, audio visual recorder and document analysis guide were used to collect data.

Author: Titus L. Mbewe, Bentry Nkhata (2019)

Title: Secondary Teachers' Mathematics Knowledge for Teaching Quadratic Equations: A Case of Selected Secondary Schools in Katete District

Journal: Zambia journal of teacher professional growth

Methodology: Qualitative data strategy was used in form of interviews, observations and questionnaire. The researcher gets closer to the people through observing teachers in a natural setting.

Research Design: A case study was done. The researcher selected participants purposefully that seeks to get information rich cases that can be studied in-depth. The researcher uses combination of maximum variation sampling in which participants

12

were chosen according to their experiences.

Data Collection methods: the researcher used observations, interviews and questionnaires.

Data Analysis: the researcher transformed interviews recorded in audio tapes and transform them into text files that were stored and reviewed. Data was manipulated by creating and applying abstract categories and use categories to compare contrast and refine distinguishable thoughts and behaviors.

Research Gaps

There is a lack of longitudinal studies that track the effectiveness of various teaching methods over time. Most existing research focuses on short-term outcomes, making it difficult to assess

the long-term impact on student learning. More research is needed on the impact of teacher training programs on the effectiveness of teaching quadratic equations. Understanding how professional development influences pedagogical choices could provide insights into improving teaching practices. While much research focuses on teacher methods, there is a need for studies that explore students' perspectives on their learning experiences with quadratic equations. Understanding students' viewpoints could inform more effective teaching strategies. The influence of cultural factors on teaching and learning quadratic equations remains underexplored. Investigating how cultural backgrounds affect students' understanding could lead to more culturally responsive teaching methods.

Conclusion

This chapter has reviewed the existing literature on the methods used by secondary school teachers to teach quadratic equations, the challenges they face, and the strategies they adopt to enhance student understanding. While various effective teaching methods have been identified, significant challenges and research gaps persist. Addressing these gaps through further research can contribute to the development of more effective teaching practices and improved student outcomes in understanding quadratic equations.

CHAPTER 3

RESEARCH DESIGN AND METHODOLOGY

3.1 Introduction

This chapter focuses on the research methodology employed in the study in an attempt to gather relevant data. The chapter also includes research paradigm, research design, population, sample and sampling procedures. A pilot study and triangulation were used to ensure validity and reliability of the instruments. Various ethical considerations for this study are highlighted in this chapter. Data collection procedure, data presentation and analysis are also highlighted.

3.2 Research paradigm

The researcher used interpretive research paradigm

3.3 Research Approach

This study used the qualitative research paradigm. A qualitative approach according to Thomas (2011) is a systematic subjective approach used to describe life experiences and to give them meaning. According to McLeod (1994) cited in Makore-Rukuni (2001), qualitative research is a process of systematic inquiry into the meanings which people employ to make sense of their experiences and guide their actions. Qualitative approach aims to gather an in-depth understanding of human behavior. It investigates the how and why questions of decision making. Qualitative approach enables the researcher to gain an insight, explore the depth, richness and complexity inherent in a phenomenon. It is holistic and reality is subjective.

In this context the qualitative research approach was more appropriate because the context in which the research was undertaken is a natural social setting, rather than a contrived or artificial one. Human behavior according to Vaughn, Boss and Schumm (2007) is seen as a contextual bound that is, there are social, historical, political and cultural antecedence that explain human behavior. The qualitative approach is a multi-method approach to capture the diversity and complexity of ideas and situations. Bordens and Abbott (2007) say that on data collection procedures the research relies heavily on field work method, in which both the researcher and the participants interact to gather the lived world experiences of participants.

Borg, Gall and Gall (2009) assert that a research approach is a process of creating an empirical test to support or refute knowledge or a claim. It is concerned with turning research questions into a project. Researchers attempt to design research so that it will yield the strongest possible evidence to support or reject knowledge or a claim. Leedy (2010) furnishes that the nature of the data and the research problem dictates the research approach. A research approach develops procedures and techniques for collecting and analyzing data. It means laying down the strategy and tactics for planning, organizing and conducting research systematically, keeping some theoretical framework in view. Thus, this approach was very relevant in this study.

3.4 Research Design

This research used the case study research design. A case study as defined by Luca (2012) as an intensive analysis of an individual or unit, for example a person, a group or event, stressing developmental factors in relation to context. It is a research strategy, an empirical study that investigates a phenomenon within its real-life context. According to Thomas (2011) a case study

is an analysis of persons, events, decisions, policies or other systems that are studied holistically by one or more methods. The description of what the study aims to achieve can be adequately addressed through the use of a case study, in which interviews and questionnaires were used.

3.5 Population

Haralambos and Holborn (2010) describe a population as a group of elements, individuals, objects or events that conform to the specific criterion to which the researcher intends to generate his or her study. It refers to all people or items with the characteristic one wish to understand. There is rarely enough time and resources to gather information from everyone in a population, thus the goal becomes finding a representative sample or subject of that population. The target population refers to members, events or objects to which the researcher would generalize the study. The population of this research comprised secondary school teachers.

3.6 Sampling

A sample according to Haralambos and Holborn (2010) is a part of a population under study and which has been selected to be a representative of the larger population. It is a small proportion of population chosen for observation, study and analysis. It is therefore a representative of a union for whose characteristics are of interest to the researcher. A sample is all about making a selection from the sampling frame in order to identify the people or issues to be included in the research. White (2005) also defines a sample as the subset of the population which is used to represent the whole population. Sampling is concerned with the selection of individuals from within a statistical population to estimate characteristics of the population.

There are various ways of sampling which includes random, probability, purposive or

judgmental, cluster and systematic sampling. One employs a method which best suits the study. In this study, purposive sampling was used. Luca (2012) defines purposive or judgmental sampling as a selection of a few people or items to form a group, with common characteristics desired for the purpose of the study, and findings from whom will be generalized to the whole population. Purposive sampling is a non-random sampling technique based on member characteristics relevant to the research problem (Best and Khan 2010). Purposive sampling selects information from the crisis cases experienced by members of a group.

The advantage of using purposive sampling is that it reduces variation, simplifies analysis and facilitates group interviewing. The method also serves time, money and effort since the participants are eager to share their ordeal, and findings will be generalized to the whole population. Thomas (2011) agrees that when conducting research, it is almost always impossible to study the entire population that you are interested in. Thus, a sample is used to draw inferences about that population.

However, Best and Khan (2010) argue that purposive sampling may not adequately represent the population, because the complexity and diversity of phenomena may not be justified by generalizing from a purposive sampling. Luca (2005) concurs that the results obtained from judgmental sample are subject to some degree of bias, due to the frame and population being identical. The frame is a list of the units, items, and people that define the population to be studied. Another weakness observed by Borg et al (2005) is that there is hardly any method to check the sampling errors, since the procedure is not systematic.

3.7 Research instruments

According to Borg et al (2009) a research instrument refers to a survey, questionnaire, test scale

or rating tool designed to measure the variables, characteristics or information of interest, often a behavior or a psychological characteristic. Orodho (2004) opines that a research instrument is for the collection of standard data from the representative sample. Therefore, the whole process of systematically gathering data is actually instrumentation. In this research, interviews were used to collect data.

3.7.1 Interviews

Bordens and Abbott (2007) define an interview as the conversation between two or more people, where questions are asked by the interviewer, to elicit facts or statements from the interviewees. The Oxford Dictionary for Business World (2010) describes an interview as a meeting held face-to-face, especially for consultation. Interviewing stems from the desire to know more about the people around us and how they view the world in which we live. Orodho (2005) adds that an interview is an interaction process direct with the subject. It involves verbal communication where the researcher gathers information that is required.

Interviews helps the researcher to gain insight into the subjective understanding of those around us by asking the participants why we are not only enabled to observe their behavior, but to subsequently understand the meaning that underlies that behavior, and to have this meaning explained to us in the participants' own words. This study used interviews to gather information on methods used by teachers when teaching quadratic equations in secondary schools.

Advantages of an interview remain that it enables the researcher to meet the participants in person and get reliable information. In an interview, there is an opportunity to rephrase some of the questions in ways that are best understood by the participants. In interviews there is great use of open-ended questions and the researcher has an opportunity of observing non-verbal cues,

which can be useful in interpreting the unspoken information. The strength of an interview technique is that it is applicable to people with varying educational levels. Vaughn, et al (2007) state that in interviews there is limited barrier of language and illiteracy, as the interviewer uses the language which is understood by the participants. Participants are asked the same questions so that comparisons for consistency could be made. Notes may be taken or tape recorded if the participants do not object. Leedy (2010) adds that a well-directed interview provides the most useful information in the shortest time possible. Another advantage of an interview is that it allows questioning to be guided as one wants it, and one can clarify points that needs to be made clear much more easily than in something like a questionnaire.

Interviews are more exploratory in nature and allows for more flexibility. Interviews also allows for higher levels of intimacy between the interviewer and the interviewees. Participants are able to respond freely in a free environment, thus the interviewer can get very elaborate answers. Interviews stimulate more open attitudes and revive participation. They also activate forgotten details and allow the interview to correct and confirm the data. Responses from semi-structured interviews are easy to summarize and analyze. The interviewer also has the opportunity to ask follow-up questions.

However, interviews are not without their demerits. They have been criticized for being time consuming and resource intensive. The interview technique relies on the respondent being willing to give accurate and complete answers. Feelings of embarrassment, inadequacy, lack of sufficient knowledge on the topic, nervousness, memory loss or confusion may hinder the participants from giving accurate information. One disadvantage of a structured interview according to Luca (2012) is that it tends to be inflexible. The researcher may miss some important information by having a highly structured interview. The status or appearance of the

interviewer may affect the responses of the participants and may influence their choice of answers. Subtle changes in the way the interviewer asks questions may elicit different answers. In this research the interviews were used with teachers teaching mathematics in secondary schools.

3.7.2 Open ended questionnaire

Best and Khan (2010) define a questionnaire as a document containing questions designed to solicit and elicit information appropriate for analysis. A questionnaire is a set of questions which are used to acquire factual information. Vaughn et al (2007) give a simpler view by saying that a questionnaire is a printed list of questions given to respondents who fill in the answers themselves without an interviewer.

Questionnaires are a quick and effective way of gathering information. They are ideal tools for gathering information because of their anonymity. In this way maximum confidentiality is ensured since the participants are not required to state their names, hence they feel at ease and safe to give information, even to divulge sensitive information without fear of victimization. A questionnaire is cost effective and saves time in that it can be given to many respondents simultaneously (Luca, 2012). Questionnaires enable the researcher to cover a large geographical area and they are also easy to standardize. The data is easy to compare, hence leads to more reliable generalizations. For example, every participant is asked the same question in the same manner, which makes it a reliable method for gathering data. Questions could either be closed or open ended. Open ended questions allow people to give their opinions while closed ended questions require no detailed writing by either the interviewer or the respondent. Closed ended questions are also relatively easy to ask and quick to answer. Their analysis is straightforward.

Closed ended questions minimize wandering and side-tracking while open ended questions allow more freedom of response and they are easy to construct (Vaughn et al, 2007).

Nonetheless, questionnaires have their own limitations. The researcher may fail to get responses in time. In some cases, not all distributed scripts will be responded to or participants may assign third parties to respond to the questionnaires. Questionnaires cannot probe the respondents if the responses are inadequate or there is need for expansion of ideas, neither do they redirect if the respondents are getting astray. There is also lack of motivation due to the autonomic nature of the technique. In this research questionnaires were used to gather information on the methods used by secondary school teachers when teaching quadratic equations.

3.8 Validity and reliability

To ensure validity and reliability of instruments, the researcher made use of multiple methods of collecting data which are questionnaires and interviews. Validity and reliability help to minimize errors. Coward (2010) asserts that validity refers to how sound or effective the measurement is. According to Haralambos and Holborn (2010) the term reliability means essentially how dependable or trustworthy the measurement is. It explains the degree in which a test consistently measures what it is intended to measure. In this study, the interview questions administered to teachers teaching mathematics in secondary schools ensuring validity and reliability of the instruments used.

3.9 Pilot study

A pilot study is defined by Best and Khan (2010) as a smaller version of the anticipated study conducted to refine the methodology. It is a small-scale preliminary study conducted in order to

evaluate feasibility time or to improve the research design. Borg et al (2009) concur that a pilot study reveals areas of weakness of the research design and instruments and improves upon them. It also validates the instruments and the questioning technique used on the instruments. Pilot testing also enables the researcher to reduce ambiguity of some questions and to standardize research instruments. It helps to assess whether an instrument has been designed in a manner that will elicit the required information. A pilot study enables the researcher to assess whether items can be understood, and to assess whether they are written at the appropriate level of complexity.

Mwamwenda (2010) furnishes that a pilot study paves a way to construct a tool that is meaningful and that accurately measures the internal validity. It assesses whether items provide a stable measure (reliability) and it also improves the procedure for administering tools. A pilot study gives the researcher experience with the subjects, setting, methodology and methods of measurements, and also to try out data analysis techniques. In this study the researcher carried out a pilot study with five respondents, so as to authenticate the instruments through triangulation.

3.10 Triangulation

Triangulation is often used to indicate that more than two methods are used in the study with the view to double or triple check the results (Hayes, 2001). Sprinthall and Oja, (2006) postulate that triangulation is a form of cross-examination. Borg et al (2009) posits that this is a method of cross-checking data from multiple sources to search for regularities in the research. The idea is that one can be confident with the results if different methods used lead to the same results.

Snowman, McCown and Biehler (2009) support this by saying that if three clashing answers are produced, the researcher knows that the question need to be reframed or the methods used reconsidered.

Snowman and Biehler (2000) point out that triangulation is a powerful tool in research that facilitates validation of data through cross verification for more than two sources. It involves application and combination of several methodologies in the study of the same phenomenon. It can be employed in both qualitative and quantitative studies. By combining multi-theories, methods and empirical materials, researchers can hope to overcome the weaknesses of intrinsic biases and problems that come from single observation and single theory studies.

For the purpose of ensuring validity and reliability of this research study, the researcher employed triangulation of research instruments. In this case both questionnaires and interviews were used to gather data from teachers. In support to this, Snowman et al (2009) contend that triangulation gives a detailed and balanced picture of the situation. It is an attempt to map out and explain more fully, the richness and complexity of human behavior by studying it from more than one standpoint. Triangulation involves the use of more than one method of enquiry and can yield substantial advantages.

3.11 Data collection procedures

In this study data was collected using interviews, open ended questionnaires. The researcher used a pilot study to establish the validity and reliability of the instruments and also to authenticate the instruments through triangulation. The researcher personally conducted the interviews. Interviews with teachers teaching mathematics in secondary schools were conducted.

Questionnaires were distributed to teachers at the school by the researcher.

The researcher set a short time frame for the collection of the completed questionnaires to avoid losing them. Participants were also encouraged to personally complete the questionnaires instead of assigning third parties.

3.12 Data presentation and analysis

This section focuses on the presentation and analysis of data. The collected responses from interviews and questionnaires were noted. Qualitative comments and discussions were made. The purpose of data presentation is to summarize and clarify meanings of raw measures, thus making data comparable (Hammersley, 2015).

3.12 Ethical considerations

Coward (2010) defines ethics as that branch of philosophy relating to human conduct, with respect to the rightness or wrongness of certain actions and to the goodness or badness of the motives and ends of such actions. Borg et al (2009) concur that ethics are concerned with human conduct and they focus on principles and standards that control relationships between individuals such as in research. These definitions imply that ethics provide guidelines for professional conduct and behavior in research. To this note the researcher adhered to various ethical principles in order to protect the rights of the participants, some of which explained below.

3.12.1 Informed consent

According to Wade and Travis (1996:70) “human subjects must voluntarily consent to participate in a study and must know enough about it to make an intelligent decision, a doctrine known as informed consent”. To this note the researcher gave participants an awareness of the

research before they chose to participate. The informed consent of the participants was sought. The researcher explained to participants the purpose of the study that is giving them explanatory information about the study to reduce the negative effects of deception. The participants were made aware that participation is voluntary and that they could withdraw at will.

3.12.2 Non-maleficence

Furthermore, the researcher adhered to the ethical principle of non-maleficence. This ethical principle clearly states that research should be for the promotion of human welfare, for the enhancement of worth, dignity, potential, and uniqueness of each individual, and the service of society. The researcher ensured that no physical or psychological harm was done to participants during the study. In addition to that, all participants were treated with fairness and equality. Borg et al (2009) concur that it is unethical to give preferential treatment to some respondents unless it is part of the research process.

3.12.3 Confidentiality

The researcher protected the anonymity of research participants and the confidentiality of their disclosures. This was echoed by Braun and Clarke (2013) and Makore-Rukuni (2001) who concur that participants value the confidentiality of their disclosures although the researcher should explain to them the limits of that confidentiality. In this study confidentiality was applied when the names of the participants were not disclosed. Research findings were generalized to ensure that the identity of the participant is not traceable. However, confidentiality and privacy may place the research process in a dilemma. This was alluded by Makore-Rukuni (2001) who asserts that on one hand, the researcher needs to publicize findings and yet, on the other hand, he or she has to maintain the client's privacy.

3.13 Summary

This chapter gave a full description of the research design and methodology employed in this study. The advantages of the research design and instrumentation used were discussed. Clarification of the population used in the study was given, followed by a description of the sample, showing its size and characteristics. The sampling procedure, which showed how the sample was arrived at, was explained. The ethics to be considered during the study were also summarized. The next chapter focuses on data presentation, analysis and discussion.

CHAPTER 4. Data Presentation, Analysis and Discussion

4.1 Introduction:

The results of a study on secondary school teachers' approaches to teaching quadratic equations at the ordinary level are presented in this chapter. The information gathered from questionnaires, interviews, and classroom observations sheds light on the typical teaching approaches, difficulties teachers encounter, and tactics used to improve students' comprehension of quadratic equations. The table below shows what has been gathered from teachers through interviews and questionnaires.

Figure1

Teaching Method	Percentage
Straight forward	50%
Group work	30%

Technology enhanced	10%
Problem solving approach	10%

4.2 Most Employed Instructional Strategies .

4.2.1 Straightforward Guidance

One of the most common approaches to teaching quadratic equations is still direct instruction. In order to illustrate the traditional form of a quadratic equation, its constituent parts, and approaches to solving it—such as factoring, completing the square, and applying the quadratic formula—teachers usually give lectures on the subject. This approach enables the organized and transparent supply of information although it may limit student interaction.

4.2.2 Learning via Problems.

Problem-based learning (PBL) was cited by numerous educators as an effective way to get pupils interested. With this method, students are given real-world issues to answer that call for the use of quadratic equations. This approach fosters critical thinking skills and enables students to recognize the application of quadratic equations in real-world situations.

4.2.3 Group Instruction

Teachers have emphasized the effectiveness of collaborative learning techniques including peer teaching and group projects. Students can improve their comprehension through debate and

cooperation by working in groups and sharing various methods for resolving quadratic equations. In the classroom, this approach encourages a sense of community and deeper comprehension.

4.2.4 Integration of Technology

Technology use, such as educational software and graphing calculators, has increased. By visualizing quadratic functions and their characteristics, these tools help bring abstract ideas to life. According to teachers, technology frequently improves student involvement and helps them comprehend the subject matter better.

4.3 Difficulties Teachers Face

4.3.1 Varying Capabilities for Learning

The wide range of learning capacities in the classroom is one of the biggest issues that educators have noticed. Different students have different levels of prior knowledge and comprehension of mathematical concepts, which might slow down the lesson's flow. It can be difficult for teachers to meet the needs of every student, especially those who need extra help. The table below shows different problems stated by teachers.

Figure 2

Challenges	Percentage
Insufficient assets	60%
Time constraints	25%

Difficulty in motivating	15%
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4.3.2 Insufficient Assets

Lack of resources, such as teaching aids and textbooks, was cited by some educators as a major obstacle. Insufficient availability of instructional resources and technology can limit the efficacy of students. A dependence on less interesting teaching strategies that might not be appealing to all students can result from this lack of resources.

4.3.3 Limited Time

Another difficulty is the curriculum's time limits. It can be challenging for teachers to get deeper into the complexity of quadratic equations since they frequently feel under pressure to cover a wide range of material in a condensed amount of time. Students may have gaps in their understanding as a result of this cursory discussion of crucial ideas.

4.4 Techniques for Improving Knowledge

4.4.1 Methods of Scaffolding

Many educators use scaffolding approaches to meet the difficulties posed by a range of learning abilities. Teachers are able to assist pupils in gradually developing their comprehension of quadratic equations by decomposing difficult ideas into smaller, more accessible components. This strategy is especially advantageous for struggling learners.

4.4.2 Formative Evaluation

In order to measure students' comprehension at every stage of the learning process, teachers reported use formative assessment techniques. Teachers can pinpoint students' areas of difficulty and modify their teaching strategies by using quizzes, group discussions, and individual feedback.

4.4.3 Applications in Real Life

It has been shown that incorporating real-world applications into classes helps pupils understand the importance of quadratic equations. In order to increase student engagement and enthusiasm to study, teachers frequently create projects or issues that are relevant to their everyday lives.

4.4.4 Career Advancement

To stay current with cutting-edge teaching strategies and resources, educators must engage in ongoing professional development. More training in effective educational techniques, especially those involving technology and collaborative learning, was requested by many educators.

4.5 Conclusion

The findings in this chapter highlight the diverse teaching methods employed by secondary school teachers when teaching quadratic equations, the challenges they face, and the strategies they utilize to enhance student understanding. While direct instruction remains common, there is a noticeable shift towards more interactive and technology-driven approaches. Addressing the identified challenges, particularly through scaffolding, formative assessments, and real-life

applications, can lead to improved student outcomes. As teachers continue to adapt their methods, ongoing support and resources will be essential for fostering a deeper understanding of quadratic equations among students.

CHAPTER 5

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1: Introduction

This chapter focuses on the summary, conclusions and recommendations of the study. A summary of the entire study shall be made with attention given to the purpose of the study, the theories that informed the study along with the research approach and design among other

components of the research methodology. Conclusions of the research findings as presented in chapter 4 shall also be proffered in this chapter. Sealing it all shall be recommendations that shall be made as informed by the findings that emerged from the study. Recommendations for further study shall also be proffered.

5.2 Summary

The purpose of the study was to establish the methods used by teachers when teaching quadratic equations in secondary schools. The study was guided by two theories that helped the researcher to appreciate the methods used when teaching quadratic equations. Constructivist and Socio-cultural theories were exploited by the study

The study made use of interpretive research paradigm since the approach intended was qualitative research approach. The study made use of interpretive research paradigm because it allowed the researcher to get immersed in the study thereby getting to experience firsthand how the participants felt since it was conducted in a natural setting. The study therefore made use of phenomenological research design since the intention was to get firsthand information on what methods are used by teachers when teaching quadratic equations in secondary schools.

Information was mainly gathered from teachers themselves. Time constraints inhibited the researcher from making contact with teachers in every school. This necessitated the extraction of a sample that would represent the entire population. Purposive sampling was used to come up with a sample of five teachers.

Interviews and questionnaires were used as instruments for data gathering. All this was done in order to allow instrumentation triangulation which is recommended when gathering of comprehensive data is to be realized.

Data trustworthiness was also observed by making sure that the instruments used were credible, transferable, dependable and confirmable. A pilot study was conducted so as to construct data gathering tools that were meaningful and that would accurately measure what they were supposed to measure.

Data was analyzed, presented and discussed thematically. Responses that made specific themes were grouped together and analyzed accordingly. A quantitative touch was given to data analysis.

In observance of the basic tenets of research studies, the researcher observed a number of research ethics. Chief among the ethics observed was informed consent. Non-maleficence, anonymity, beneficence and plagiarism were some of the ethics that the researcher observed.

5.3 Conclusions

The study established that most methods used by teachers when teaching quadratic equation in secondary schools are completing the square, graphical methods and quadratic formula

5:4 Recommendations

Teachers should diversify their instructional approaches by integrating various teaching methods, such as direct instruction, problem-based learning, and collaborative learning. This variety can cater to different learning styles and keep students engaged. Regularly rotating between these methods can help maintain student interest and deepen understanding. To enhance student engagement, teachers should emphasize the relevance of quadratic equations through real-world applications. Incorporating projects that relate quadratic equations to everyday situations can help students appreciate the importance of the subject matter and motivate them to learn.

Teachers should be encouraged to incorporate technology into their lesson plans, using tools such as graphing calculators and educational software. Professional development workshops can be organized to familiarize teachers with these technologies, thereby improving their confidence and ability to integrate them into their teaching.

Ongoing professional development is essential for teachers to stay updated on effective teaching methods and resources. Schools should invest in training sessions focused on innovative pedagogical strategies, including differentiated instruction and the use of technology in mathematics education. Encouraging a collaborative learning environment can help address diverse student needs. Schools should promote activities that enable peer teaching and group work, allowing students to learn from one another and develop a deeper understanding of quadratic equations. Schools should review the mathematics curriculum to ensure adequate time is allocated for teaching quadratic equations. Extending the time frame for this topic can allow teachers to cover material more thoroughly and provide students with the opportunity to engage deeply with the content.

Teachers should be trained in scaffolding techniques to support students with varying abilities. By breaking down complex concepts into smaller, manageable parts, teachers can guide students through the learning process, building confidence and understanding as they progress. Regular formative assessments should be integrated into lesson plans to monitor student understanding continuously. Teachers can use quizzes, discussions, and informal assessments to identify areas where students may struggle and adjust instruction accordingly.

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APPENDIX A

Questionnaire for teachers

This questionnaire aims to identify the most commonly used teaching methods for quadratic equations at the secondary school level. Your participation will contribute to a better understanding of effective teaching practices.

1. Which of the following teaching methods do you use to teach quadratic equations? (Select all that apply)

- graphical method
- completing the square
- Factorization
- Group work
- Quadratic formula
- Other (please specify)

2 How often do you use each of the following teaching methods when teaching quadratic equations? (Scale: 1 = Rarely, 2 = Occasionally, 3 = Frequently, 4 = Almost always)

- graphical method
- completing the square
- Factorization
- Group work
- Quadratic formula

3. Which teaching method do you think is most effective for teaching quadratic equations?

(Select one)

4. What resources do you use to support your teaching of quadratic equations? (Select all that apply)

- Textbook
- Online resources
- Graphing calculators
- Software
- Real-world examples
- Other (please specify)

5. Have you received any professional development or training on teaching quadratic equations?

(Select one)

- Yes

-No

Thank you for taking the time to participate in this questionnaire. Your input will contribute to a better understanding of effective teaching practices for quadratic equations at the secondary school level.

This questionnaire aims to identify the challenges faced by teachers when teaching quadratic equations at the school level. Your participation will contribute to a better understanding of the difficulties teachers encounter and inform strategies for improvement.

1. What challenges do you face when teaching quadratic equations? (Select all that apply)

- Student lack of understanding of prerequisites (e.g., algebra, geometry)
- Difficulty in motivating students
- Limited resources (e.g., textbooks, technology)
- Insufficient time for instruction
- Student difficulty with abstract concepts
- Student struggle with problem-solving and application
- Other (please specify)

2. How often do you encounter the following challenges when teaching quadratic equations?

(Scale: 1 = Rarely, 2 = Occasionally, 3 = Frequently, 4 = Almost always)

- Student lack of understanding of prerequisites
- Difficulty in motivating students
- Limited resources
- Insufficient time for instruction

- Student difficulty with abstract concepts
- Student struggle with problem-solving and application

3. What do you think is the most significant challenge you face when teaching quadratic equations? (Select one)

4. Can you describe a particularly challenging experience you've had when teaching quadratic equations?

5. How do you think the challenges you face when teaching quadratic equations could be addressed?

Thank you for taking the time to participate in this questionnaire. Your input will contribute to a better understanding of the challenges teachers face when teaching quadratic equations and inform strategies for improvement. This questionnaire aims to explore the strategies and methods used by secondary school teachers to help students understand the quadratic concept. Your participation will contribute to a better understanding of effective teaching practices.

1. Which of the following teaching strategies do you use to help students understand quadratic concepts? (Select all that apply)

- Direct instruction
- Guided practice
- Independent practice
- Group work

- Project-based learning
- Real-world applications
- Technology-enhanced instruction (e.g., graphing calculators, software)
- Other (please specify)

2. How often do you use each of the following teaching strategies when teaching quadratic concepts? (Scale: 1 = Rarely, 2 = Occasionally, 3 = Frequently, 4 = Almost always)

- Direct instruction
- Guided practice
- Independent practice
- Group work
- Project-based learning
- Real-world applications
- Technology-enhanced instruction

3. What do you think is the most effective teaching strategy for helping students understand quadratic concepts? (Select one)

4. How do you assess student understanding of quadratic concepts? (Select all that apply)

- Written tests
- Quizzes

- Projects
- Classwork
- Homework
- Other (please specify)

5. What types of feedback do you provide to students when teaching quadratic concepts? (Select all that apply)

- Verbal feedback
- Written feedback
- Peer feedback
- Self-assessment
- Other (please specify)

Thank you for taking the time to participate in this questionnaire. Your input will contribute to a better understanding of effective teaching practices for quadratic concepts.

APPENDIX B

INTERVIEW GUIDE

Hello, thank you for agreeing to participate in this research study. My name is Nyevero Masimba and I am a Student at Bindura University. This interview aims to explore the teaching methods used by secondary school teachers when teaching quadratic equations at Ordinary Level. Your responses will be kept confidential and anonymous.

Teaching Methods

1. What teaching methods do you typically use when introducing quadratic equations to your students?
2. Can you describe a specific lesson or activity you use to teach quadratic equations?
3. How do you assess student understanding of quadratic equations during and after instruction?
4. Do you use any technology (e.g., graphing calculators, math software) to support your teaching of quadratic equations? If so, how?
5. How do you differentiate instruction for students with varying learning needs and abilities?

Challenges and Support

1. What challenges do you face when teaching quadratic equations to your students?
2. How do you support students who struggle with quadratic equations?
3. Are there any resources or professional development opportunities that you have found helpful in improving your teaching of quadratic equations?

Reflection and Future Directions

1. Reflecting on your teaching practice, what do you think are the most effective methods for teaching quadratic equations?
2. Are there any changes you would like to make to your teaching practice in the future?
3. Do you have any recommendations for educators or policymakers looking to improve the teaching and learning of quadratic equations?

Thank you for taking the time to share your insights and experiences with me today. Your contributions will help inform strategies for improving the teaching and learning of quadratic equations. Do you have any final comments or thoughts you'd like to share?

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