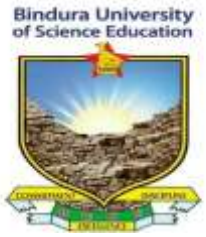

The effects of geogebra in overcoming problems in solving geometrical transformation

A dissertation submitted in partial fulfillment of the required for the diploma in science education curriculum studies

By

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In the

Faculty of science education

Department of curriculum and educational management studies

A RESEARCH PROJECT SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS OF THE DIPLOMA IN SCIENCE EDUCATION (MATHEMETICS AND GEOGRAPHY)

JULY 2024

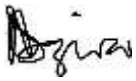
DECLARATION

I, Boniface Kudzai Gwata. Hereby declared that except for references to other people's work which have been duly acknowledged this dissertation is the result of my research and has neither in part nor in whole been presented in the education programme.

Signed: 

APPROVAL FORM

The undersigned certify that they have supervised, have read and recommend to the University for Acceptance and examination a research project entitled: the effects of geogebra in overcoming problems in solving geometrical transformation at Sandringham high school by Boniface. K. Gwata in partial fulfillment of the requirement for the award of the Diploma in Science Education.

Supervisor:  Date: 05/07/2024

DEDICATION

I dedicate this dissertation to my family with special mention of my father Fidelis Gwata, my mother Ronia Mapudzi, my sister Paidamoyo Gwata and all my friends the likes of Tadiwanashe Mpofu and Munashe Marowa who were supportive to me, financially and morally during the whole study. Without their support and encouragement, this work could not have been accomplished.

ACKNOWLEDGEMENT

First and foremost, I offer my gratitude to the creator, my God for guiding me and protecting me throughout the entire process of my learning up to this level.

I would like to thank Dr D. Dziva my academic supervisor for his efforts to mold the best out of me as far as this research study is concerned. He successfully shepherded through this study with unwavering support from the start to the end of this period in coming up with a document.

I also dedicate my sincere acknowledgments to Sandringham school head, teachers and learners for their cooperation and assistance rendered during the lessons, pretest and post-test.

I would like to thank my family members also who support me during the time of my study physically and morally. It is through the dedication, commitment and encouragement that I have managed to complete this study.

ABSTRACT

Geometric transformations are a fundamental topic in secondary mathematics, but students often struggle to develop a deep conceptual understanding of the underlying principles. This study investigates how the use of the dynamic mathematics software GeoGebra can help overcome common issues students face when learning about translations, rotations, reflections, and dilations. The research employed a quasi-experimental design, including pre-test and post-tests, classroom observations, and student interviews. Participants were 50 Sandringham high school form 3 mathematics students who were randomly assigned to either a control group using traditional instructional methods or an experimental group that utilized GeoGebra based lessons and activities. The results indicate that the GeoGebra, enabled instruction had a significant positive impact on student learning. The experimental group demonstrated greater gains in their ability to accurately identify, describe, and perform geometric transformations compared to the control group. Quantitative data revealed that GeoGebra's dynamic visualization, interactive features, and multiple representational capabilities were particularly helpful in developing students' conceptual understanding and problem-solving skills. The findings suggest that incorporating GeoGebra into the teaching of geometric transformations can be an effective strategy for overcoming common student difficulties in this area of mathematics. Implications for educational practice and directions for future research are discussed.

Keywords: geometric transformations, GeoGebra, visualization, conceptual understanding

TABLE OF CONTENT

CHAPTER 3 RESEARCH METHODOLOGY

CHAPTER 4 DATA PRESENTATION, ANALYSIS, AND INTERPRETATION

CHAPTER 5 SUMMARY, CONCLUSION, AND RECOMMENDATIONS

LIST OF TBLES

List of APPENDICIES

Chapter One

Problem and its setting

1.0 Introduction

In this chapter, the problem is put into context through the discussion of the following: introduction, background of the study, statement of the problem, research question, significance of the study, limitation, Delimitations, assumptions, definitions of key terms and summary of chapter one.

1.1 Background to the study

The study aims to investigate the effectiveness of using geogebra, a dynamic mathematics software, in helping students overcome difficulties in solving geometric transformation problems. Geometric transformation is a fundamental topic in geometry that involves manipulating shapes through translations, rotations, reflections, and dilation. Many students struggle with visualizing and executing these transformations accurately, leading to errors and misconceptions. Geogebra offers a powerful platform for exploring and visualizing geometric concepts through interactive constructions and dynamic representations. By providing a hands-on and visual approach to

Learning, Geogebra has the potential to enhance students' understanding of geometric transformations and improve their problem-solving skills.

Through this study, the researchers seek to analyze the impact of integrating Geogebra into the teaching and learning process of geometric transformation. By comparing the performance of students who use Geogebra with those who do not, the study aims to determine whether the software can effectively support students in overcoming challenges and misconceptions in solving geometric transformation problems.

The findings of this study have the potential to provide valuable insights into the use of educational technology in teaching geometry and inform educators on best practices for integrating digital tools to enhance student learning in mathematics.

GeoGebra is a dynamic mathematics software that has been widely used in education to enhance students' understanding and problem-solving skills in various mathematical concepts, including geometric transformations. In this literature review, we will examine the existing research on the effects of GeoGebra in overcoming problems in solving geometric transformations.

One of the key benefits of using GeoGebra in teaching geometric transformations is its ability to provide students with a visual representation of geometric shapes and their transformations. Research has shown that visualization plays a crucial role in students' understanding of geometric concepts a study by (Liu, 2010). GeoGebra's interactive and dynamic environment allows students to explore and manipulate geometric shapes in various ways, which can help to build their spatial reasoning and problem-solving skills.

Studies have shown that GeoGebra can improve students' achievement and understanding in geometric transformations. For example, a study conducted by (Sarma et al., 2016) found that students who used GeoGebra to learn geometric transformations scored higher on a test of geometric transformation concepts than students who learned through traditional teaching methods. Similarly, a study by (Kostelas et al., 2017) found that students who used GeoGebra to learn geometric transformations showed a greater understanding of the concepts and were able to solve problems more effectively than students who did not use GeoGebra.

GeoGebra has also been found to be effective in helping students overcome common misconceptions in geometric transformations. A study by (Wong et al., 2017) found that students who used GeoGebra to learn about reflection and rotation had fewer misconceptions about these concepts than students who learned through traditional teaching methods. Similarly, a study by (Tall & Schwartz, 2006) found that students who used GeoGebra to learn about geometric transformations were less likely to make errors in solving problems than students who did not use GeoGebra.

In addition, GeoGebra has been found to be effective in promoting students' engagement and motivation in learning geometric transformations. A study by (Zheng et al., 2018) found that students who used GeoGebra to learn geometric transformations reported higher levels of engagement and motivation than students who learned through traditional teaching methods. Similarly, a study by (Sarma et al., 2016) found that students who used GeoGebra to learn geometric transformations reported higher levels of satisfaction and enjoyment than students who did not use GeoGebra.

Overall, the research suggests that GeoGebra is an effective tool for overcoming problems in solving geometric transformations. GeoGebra's interactive and dynamic environment allows students to explore and manipulate geometric shapes in various ways, which can help to build their spatial reasoning and problem-solving skills. GeoGebra has also been found to be effective in promoting students' engagement and motivation in learning geometric transformations, and in helping students overcome common misconceptions in these concepts

1.2 Statement of the Problem

The use of GeoGebra in overcoming problems in solving geometric transformations for example lack of visualization skill, incorrect placement of transformation figures, difficult in identifying invariant properties and problem-solving skills. GeoGebra is a powerful tool that allows students to explore and interact with geometric shapes in a dynamic and visual way. However, there is a lack of research on the effectiveness of GeoGebra in improving students' understanding and problem-solving skills in geometric transformations.

1.3 Research Questions

This study aims to investigate the effectiveness of GeoGebra in improving students' understanding and problem-solving skills in geometric transformations. Specifically, the study will address the following research questions:

1. How effective does the use of GeoGebra compare to traditional teaching methods in terms of student achievement in geometric transformations?

2. How does the use of GeoGebra affect students' spatial reasoning and visualization skills in geometric transformations?

3. How does the use of GeoGebra impact students' attitudes towards mathematics and their motivation to learn geometric transformations?

By addressing these research questions, the study aims to provide insights into the effectiveness of GeoGebra in improving students' understanding and problem-solving skills in geometric transformations, and to inform the development of effective teaching strategies for this topic

1.4 Significance of the Study

The study on the effect of GeoGebra in overcoming problems in solving geometric transformation is significant in several ways: Improved understanding of geometric transformation: GeoGebra allows students to visualize and manipulate geometric shapes, which can help them develop a deeper understanding of geometric transformation concepts. Enhanced problem-solving skills: By using GeoGebra, students can explore and experiment with different geometric transformation techniques, which can help them develop their problem-solving skills and increase their confidence in solving problems. Increased engagement and motivation: GeoGebra's interactive and visual nature can make learning more engaging and motivating for students, which can lead to higher levels of achievement and interest in mathematics. Better preparation for higher-level mathematics: GeoGebra can help students develop the skills and understanding needed to succeed in higher-level mathematics courses, such as calculus and physics. Improved spatial reasoning: GeoGebra's 3D visualization capabilities can help students develop their spatial reasoning skills, which are essential for success in many fields, including engineering, architecture, and science. Cost-effective: GeoGebra is a free software, making it a

cost-effective tool for schools and students, especially in comparison to other graphing software that can be expensive. Accessibility: GeoGebra can be used by students with different learning styles and abilities, making it an inclusive tool for education. Real-world applications: GeoGebra can be used to model and analyze real-world problems, making mathematics more relevant and applicable to students' lives. Teacher professional development: GeoGebra can be used to enhance teacher professional development, providing teachers with a tool to improve their own understanding of geometric transformation and other mathematical concepts.

Overall, the study on the effect of GeoGebra in overcoming problems in solving geometric transformation has the potential to provide valuable insights and benefits for students, teachers, and the broader educational community.

1.5 Limitations

Geogebra is a powerful software tool that combines dynamic geometry, algebra, and calculus functionalities. It can be used to explore and solve various problems in geometric transformations. While Geogebra can be beneficial in overcoming certain challenges, it also has its limitations. Here are some limitations to consider when using Geogebra for solving geometric transformation problems:

Limited Representations: Geogebra provides a visual representation of geometric objects and transformations. However, it may not accurately represent all real-world scenarios. Geogebra works in a two-dimensional space, and complex three-dimensional transformations may not be accurately visualized or solved. Simplified Models: Geogebra simplifies geometric concepts and transformations by using idealized mathematical models. In reality, objects may have

imperfections, and transformations may be subject to constraints or limitations. Geogebra's models may not always capture these real-world complexities. User Proficiency: Geogebra requires users to have a certain level of proficiency in using the software. While it provides a user-friendly interface, there is still a learning curve associated with mastering the software's features and functionalities. Inexperienced users may face challenges in effectively utilizing Geogebra to solve geometric transformation problems. The research will use a pretest and post-test experimental design, with one group using Geogebra to solve geometric transformations and another group using traditional methods. A sample size of 50 students will be divided into two groups, with 25 students in the Geogebra group and 25 students in the traditional methods group. On data collection the researcher is going to use questionnaire.

1.6 Delimitations

Delimitations refer to the boundaries or limitations set for a particular study or research topic. In the context of the effect of GeoGebra in overcoming problems in solving geometric transformations, the delimitation can be defined as follows: Scope of Geometric Transformations: The study focuses on specific types of geometric transformations, such as translations, rotations, reflections, and dilations. It may not encompass more advanced transformations like shearing or complex combinations of transformations. Educational Setting: The research is limited to the use of GeoGebra in educational settings, such as classrooms or online learning environments. It may not consider other professional or research contexts. Target Audience: The study may target a

specific audience, such as students at a particular educational level (e.g., high school or undergraduate level) or teachers who instruct geometry. Comparative Analysis: The research may compare the effectiveness of GeoGebra with other tools or methods used for teaching and learning geometric transformations. This study focused on one selected high school under Chegutu District (Sandringham high school). This school offers basic education which is form 1-6 with 1000 students. On this study I mainly focused on form 3 and 4

1.7 Assumptions

Geogebra is a dynamic mathematics software that combines geometry, algebra, and calculus. It provides a visual and interactive approach to solving geometric problems, making it a valuable tool for overcoming challenges in geometric transformations. Here are some assumptions about the effects of Geogebra in overcoming problems in solving geometric transformations: Visualization: Geogebra allows users to create and manipulate geometric objects, enabling a visual representation of the transformation process. This visual approach helps users understand the underlying concepts and relationships involved in geometric transformations.

Interactive Exploration: Geogebra offers an interactive environment where users can explore different transformations by dragging and manipulating objects. This interactivity allows for hands-on experimentation, enabling users to observe the effects of different transformations and gain insights into their properties. Real-Time Feedback: Geogebra provides real-time feedback on geometric transformations. As users modify objects or apply transformations, they can immediately see the corresponding changes. This instant feedback helps users identify errors, refine their approach, and gain a deeper understanding of geometric transformations. Multiple Representations: Geogebra supports multiple representations of geometric objects, such as

algebraic equations, coordinates, and graphical representations. This versatility allows users to approach geometric transformations from different perspectives, fostering a comprehensive understanding of the concepts involved. Dynamic Construction: Geogebra allows users to construct geometric figures dynamically. This feature is particularly useful when solving problems that involve constructing or dissecting shapes. Users can create and modify figures on the fly, facilitating experimentation and problem-solving. Integration of Algebra and Geometry: Geogebra seamlessly integrates algebraic and geometric representations. Users can define relationships between variables, equations, and geometric properties, enabling them to solve geometric transformation problems using algebraic methods. This integration bridges the gap between algebra and geometry, enhancing problem-solving capabilities. Accessibility and Availability: Geogebra is a free and open-source software available on multiple platforms, including desktop, web, and mobile. Its accessibility and availability make it widely accessible to students, teachers, and mathematicians, providing a common platform for collaboration and learning. While Geogebra can be a powerful tool for overcoming problems in solving geometric transformations, its effectiveness ultimately depends on how it is used. Proper understanding of geometric concepts, thoughtful experimentation, and critical thinking are still essential for successful problem-solving, even with the aid of Geogebra.

1.8 Definition of Key Terms

Transformation, according to Baddoe (2023), transformation is a way to map a function or shape onto itself. It also defines as, the manipulation of a geomatric shape or formula that maps the shape from its preimage or original position to its image. Transformation has three types which

are rotation, reflection and translation. Rotation this is when you spin a shape or a function. Reflection means to flip a shape or a function about a specific point. According to Hohenwarter (2024), Geogebra is a dynamic mathematics software for all levels of education that brings together geometry, algebra, graphing, statistics and calculus in one engine. Geometric transformation refers to the process of manipulating the shape, location or size of an object. (Gonzalez, 2008). Visualization is the process of creating visual presentations of data or information to better understand patterns, relationships and trends. Dynamic mathematical software refers to computer program that allow users to interactively explore and manipulate mathematical concepts, function and models in real-time.

1.9 Summary

The forgoing chapter provided a background to the study in which the origins of the research problem are outlined. The chapter subsequently laid out the statement of the problem, the objectives the study seeks to fulfill and the research questions that the study ultimately seeks to answer. The significance of the study was then outlined. Subsequently, the limitations and the research assumptions were presented. Finally, the chapter provided a definition of terms and chapter outline. This section gives an overview of what each chapter of this study will cover. The chapters will be articulated as follow: chapter 1 articulates the problem and setting, chapter 2 identifies the gaps in the literature, that this study intends to fill and chapter 3 outlines the methodology that will guide the data collection, analysis and interpretation, chapter 4 focusing on data presentation to provide answers to issues raised in chapter 1 and chapter 5 provides the summary of the project, conclusion and recommendations made based on the results.

.CHAPTER 2

LITERATURE REVIEW

2.0 INTRODUCTION

Geogebra is a dynamic mathematics software that integrates geometry, algebra, and calculus into one platform, allowing for interactive exploration and visualization of mathematical concepts. In recent years, there has been a growing interest in using Geogebra as a tool to enhance students' understanding of geometric transformations.

2.0.1 Effectiveness of geogebra

A study by Montes et al. (2018) investigated the effectiveness of using Geogebra in a flipped classroom setting to teach geometric transformations. The researchers found that students who engaged with Geogebra activities outside of class had a better understanding of geometric transformations and were able to apply their knowledge to solve complex problems. Several studies have shown the positive effects of using Geogebra in overcoming problems in solving geometric problems. One study conducted by Kurnaz and Özdemir (2010) found that students who used Geogebra to solve geometric problems showed significant improvements in their problem-solving abilities compared to those who did not use the software. The researchers

attributed this improvement to the dynamic nature of Geogebra, which allowed students to visualize geometric problems and explore different solutions in a hands-on manner.

2.0.2 Effects of geogebra in student□s spatial reasoning and visualization skill

study by Sánchez et al. (2016) found that students who used Geogebra to explore geometric transformations showed significant improvement in their understanding and ability to solve transformation problems compared to students who used traditional paper-and-pencil methods. A study conducted by Kurnaz and Özdemir (2010) found that students who used Geogebra to solve geometric problems showed significant improvements in their problem-solving abilities compared to those who did not use the software. The researchers attributed this improvement to the dynamic nature of Geogebra, which allowed students to visualize geometric problems and explore different solutions in a hands-on manner.

2.0.3 Impacts and motivations of geogebra

A study by Tsai and Chiu (2017) examined the impact of using Geogebra in a geometry course on students' problem-solving skills. The results showed that students who used Geogebra had higher problem-solving performance and were more likely to successfully solve geometric transformation problems compared to students who did not use the software. Another study by Hohenwarter and Preiner (2007) found that students who used Geogebra to solve geometric problems demonstrated higher levels of motivation and engagement in the learning process compared to those who used traditional paper-and-pencil methods. The researchers suggested that the interactive nature of Geogebra, which allows students to manipulate geometric figures and explore different concepts in real-time, contributed to this increase in motivation and engagement. A study by Artigue and his colleagues (2013) explored the impact of Geogebra on

students' cognitive processes when solving geometric problems. The researchers found that students who used Geogebra showed greater flexibility in their problem-solving strategies and were able to approach problems from multiple perspectives. This suggests that Geogebra not only helps students find solutions to geometric problems but also enhances their critical thinking and problem-solving skills.

2.1 SUMMARY

The literature supports the positive effects of Geogebra in overcoming problems in solving geometric problems. The software's interactive and dynamic features allow students to visualize concepts, explore different solutions, and enhance their problem-solving abilities. Educators can leverage the benefits of Geogebra to create engaging and interactive learning experiences for students, ultimately improving their understanding and proficiency in geometry. The literature suggests that Geogebra can be a valuable tool for helping students overcome problems in solving geometric transformations. By providing a visual and interactive environment for exploring mathematical concepts, Geogebra can enhance students' understanding and problem-solving skills in geometry. Further research is needed to explore the long-term effects of using Geogebra in teaching geometric transformations and to identify best practices for integrating the software into the classroom.

CHAPTER 3

RESEARCH METHODOLOGY

3.0 Introduction

The purpose of this research is to investigate the effects of using Geogebra in overcoming problems in solving geometric transformation. This study will examine how Geogebra can enhance students' understanding of geometric transformations, improve their problem-solving skills, and increase their engagement and motivation in learning mathematics. The research methodology will involve implementing Geogebra in a classroom setting and conducting pretest and post-tests to assess students' knowledge and skills in solving geometric transformation problems. The data collected will be analyzed using statistical methods to determine the impact of Geogebra on students' performance and attitudes towards learning geometry. The chapter is going to describe the research design, sample and sampling procedures, data collection instrument, data collection procedures and research integrity.

3.1 RESEARCH DESIGN

Trochim (2006) holds that the research design refers to all the overall strategy that research choose it integrate the different components of the study coherently and logically, thereby ensuring you will effectively address the research problem, it constitute the blue print for the collection, measurement and analysis of data. The researcher use quantitative approach.

The quantitative approach is regarded as the organized inquiry about the phenomenon through the collection of numerical data and execution of statistical, mathematical, or computational techniques (Slevitch, 2011). The quantitative approach advocates for approaches embedded in the statistical breakdown that involves other strategies like inferential statistics, testing of hypothesis, mathematical exposition, experimental and quasi-experimental design randomization, blinding, structured protocols, and questionnaires with a restricted variety of prearranged answers (Slevitch, 2011). Its purpose is to attain greater knowledge and understanding of the social world. The quantitative approach produces objective data that can be communicated through statistics and numbers. In the quantitative approach, sample size and sampling design considerations usually are made to make statistical generalizations, which involve generalizing findings and inferences from the representative statistical sample to the population from which the sample was drawn (Onwuegbuzie & Leech, 2005)

3.2 Population and Sample/Research Participants

A sample is a subset of a population selected to participate in the study, it is a fraction of the whole, selected to participate in the research project (Brink, 2009). In this study, a subset of 50 learners was selected out of 100 form 3 mathematics learners. The process of selecting a portion of the population to represent the entire population is known as sampling (Haber, 2005). The

researcher used random sampling in coming up with a sample comprised of 50 learners. Thus, each respondent has an equal probability of being chosen (Brink, 2009). A sample chosen randomly is meant to be an unbiased representation of the total population (Onwuegbuzie & Leech, 2005). In selecting 4 teachers to be part of the sample purposive or judgmental sampling was used. Hence, purposive or judgmental sampling is a strategy in which particular settings persons or events are selected deliberately to provide important information that cannot be obtained from other choices (Maxwell, 2009). It is where the researcher includes respondents in the sample because they believe that they warrant inclusion

3.3 Study context and description

3.3.1 Study Context

The research focus on the effectiveness of geogebra in overcoming problems in solving geometrical transformations. Participants of this study are Sandringham high school students in a mathematics class. The researcher assume that they have prior knowledge on basic understanding of geometrical transformation.

3.3.2 Description

The study aim to investigate how geogebra can help students to overcome common problems and difficulties in solving transformation such as; visualizing and understanding, calculating coordinates and angles and applying transformation to real-world problems. The research apply quantitative research approach. The researcher use pretest and post-test to assess student' s understanding of transformation. The study will provide insight into the effectiveness of geogebra as a tool for teaching and learning geometric transformations and inform the

development of instructional materials and strategies that integrate technology in a meaningful way. The finding will provide valuable insights for teachers and researchers on the effectiveness of geogebra as a tool for teaching and learning transformation.

3.4 Ethical consideration

The following ethical issues were considered in the study: informed consent, privacy and confidentiality

3.4.1 Informed consent

Informed consent means knowing of research participants and all the information related to the research they wish to participate in. the benefits, harms, and other issues of research are disclosed to the participants so that they choose whether to participate or not. Participants will be informed about the study and also receive a description of the intended use of data that will generated.

3.4.2 Privacy

The participants had a right to decide when, where, to whom and to what extend their knowledge were to be used. The participant' s right to privacy was not violated by the unauthorized use of one way mirrors or any other methods that may interfere with privacy. Any form of identification of the participants was not regarded in the research. As the result participants were assured of privacy and confidentiality.

3.4.3 Confidentiality

The researcher tried by all means to protect the confidentiality of the participants from other in the study and the general public. Participant were assured that the information they provided will be treated with strict confidence and can be used for academic purpose only and their identities will be protected

3.5 Research Instrument

Researchers use pretest and post-tests to assess students' knowledge and skills before and after using Geogebra for geometric transformation problem-solving. These tests can measure the effectiveness of Geogebra in improving students' understanding and ability to solve geometric transformation problems. Pretest provides a baseline measure of students understanding and abilities prior to the intervention while post-test assesses their learning and progress after the intervention.

3.6 DATA COLLECTION PROCEDURES

On data collection, the research recruit a sample of one high school in Chegutu district who currently learning about geometrical transformation, aim for a diverse sample in terms of academic performance, prior experience with geogebra and demographic factors. The researcher divide the participants into two groups: control group that learn using traditional method and experimental group which use geogebra. The researcher provide the participants with lessons on how to use geogebra for them to solve geometrical transformation such as reflection, rotation, translation and dilation. Administer a pretest to assess baseline understanding and problem solving skills and a post-test to both groups.

3.7 DATA ANALYSIS

Statistics were used to analysis quantitative data. Frequency table of the pretest for the two groups were drawn and respective percentage and mean were calculated and compared. The comparison was done to establish the entry points of the participants in order to alleviate bias after the treatment. The mean were compared to ascertain whether the participants were starting from the same level to improve the validity of the result.

3.8 CHAPTER SUMMARY

This chapter outline the strategy that was used in the data collection and analysis through the following, research design, population and sample size, ethical considerations, research instruments, data collection procedures and study context and description. The next chapter focuses on data presentation, analysis and interpretation.

CHAPTER 4

DATA ANALYSIS AND INTERPRETATION

4.1 INTRODUCTION

In the preceding chapter, the methodological framework for this research was detailed, encompassing the research design, participant selection, data collection instruments, and the procedures for analysis. This chapter now turns to the presentation, analysis, interpretation and discussion of the data gathered. The primary aim is to address the research questions posed in Chapter 1, specifically focusing on the effectiveness of GeoGebra in overcoming the challenges students encounter when solving geometric transformation problems. Through an examination of the quantitative results obtained from pre-test and post-test assessments, this chapter will illuminate the impact of GeoGebra on student learning outcomes and shed light on the underlying mechanisms through which this technology facilitates enhanced understanding and problem-solving skills. In the previous chapter the strategy for data collection and analysis was outlined, in this chapter the collected data will be presented, analyzed and interpreted with the view to provide the issues in chapter one.

4.1.1 Organization of data analysis

The researcher employs quantitative analysis, this can involve conducting statistical tests to measure the impacts of using geogebra on the student learning outcomes. In this study it is used to compare the pretest and post-test scores of students who used geogebra versus those who used

traditional methods. In this study the researcher use t-test to compare means assess the significance of any difference.

4.2 Characteristics of the participants

This section articulates the outstanding demographic characteristics of the selected respondents.

Table 4.1: Characteristics of selected learners [n =50]

Attribute(s)	(n)	%
male	20	40
female	30	60
Form 3	50	100

Table 4.1 shows the distribution of the respondents according to sex, age and level of education. The number of respondents is fifty and they were 20 male and 30 females learners participate in the study. The table shows the age ranges from 14-17 years. The following table below show the outstanding characteristics of the selected teachers. Students have prior experience on basic understanding of shapes, angles and basic geometric concept from form 1 and 2. They are also familiar with geometrical tools like compass and protractors. Student have little access of geometrical tools outside of the school because some of students does not have laptops and cellphones. Most of the selected student have a positive attitude towards mathematics and few of them struggle to understand concept or complete assignments.

Table 4.2 Characteristics of selected teachers (n=2)

Attribute(s)	(n)	%
male	1	50
female	1	50
Professional Qualifications		
Diploma in education	1	50
Degree in education	1	50
Teaching experience (years)		
0-5	2	100

Table 4.2 shows the distribution of the two teachers according to gender professional qualification and teaching experience. Of the two teachers who participated in the study we have one female and one male. It also shows the distribution according to their qualifications, in which one has a diploma in mathematics education and the other have a degree in mathematics education. All two teacher has 5 or less years of experience in teaching. These levels of experience made it possible to give different contributions to the study because they had interact with form 3 mathematics learners for some time. The selected teacher have little experience with geogebra because they mostly use the traditional method.

4.3 Address to the research problem/ questions

This section address the research questions

4.3.1 The effectiveness of geogebra compared to traditional method

Geogebra have positive impact on learner' s performance and it encourages discovery learning and the visualization of geometrical transformation. It also aids in the teaching and comprehension of abstract transformation concepts.

Table 4.3 learner' s performance in pretest

Learners score out of 20	**0-9**	**10-19**	**20**	**Mean mark**	**total**
Experimental group (use geogebra)	3	15	7	13.5	25
Control group (use traditional method)	10	10	5	10.72	25

The table 4.3 shows results for the pretest for both groups the experimental group which uses geogebra and control group which uses traditional method. The table show that learners which uses geogebra has only 3 learners which score less than half compared to the control group which has 10 learners. The difference in their mean shows the effectiveness of the use geogebra.

The following table show learners performance in post-test. These results in pretest and post-test shows that geogebra is effective in overcoming problems in solving geometrical transformation. The t-test result indicate that the mean score of students who use geogebra is 13.5 is significant

X

supervisor

high than the mean of students who used traditional method 10.72 at p-value<0.05

Table 4.4 learner□s performance in post-test

Learners score out of 20	0-19	20-39	40	Mean mark	total
Experimental group (use geogebra)	2	20	3	16.28	25
Control group (use traditional method)	15	7	3	10.28	25

Table 4.4 show learners performance in post-test where 23 learners how use geogebra score marks which is above 20 compared to traditional method which has only 10 learners out of 25 which score mark which is above half. This show that geogebra improves visualization and understanding in learners. They mean difference shows that geogebra is effective in teaching and learning of geometrical transformation compared to traditional method which use chalks and boards.

4.3.2 How does the use of geogebra affects student□s spatial reasoning and visualization skills in geometrical transformation.

Geogebra provides a visual platform where students can see the effects of geometrical transformation in real-time. This allows them to develop a deeper understanding of concepts like rotations, reflection and translation and how they affect the position and properties of shape. The use of geogebra increased problem solving skills. The results of post-test and pretest shows that geogebra encourages learner to develop a critical thinking skills, logical reasoning and the ability to analyze and solve geometrical problems. In this case geogebra serve as a powerful tool for enhancing student' s spatial reasoning and visualization skills in geometrical transformation. It provides a dynamic, interactive and visual learning environment that supports student' s exploration, problem solving and concept understanding.

4.3.3 How does the use of geogebra impacts student□s attitudes towards mathematics and their motivation to learn geometric transformation.

Geogebra allows students to visualize and interact with geometrical transformation. This visual approach can make the concepts more engaging and easier to understand compared to textbook examples. The results of post-test and pretest shows that geogebra encourages learner to develop a critical thinking skills, logical reasoning and the ability to analyze and solve geometrical problems. It explore discovery-based learning approach can foster a sense of curiosity and motivation as students actively investigate the properties of geometrical transformation. When students manipulates objects on geogebra they receive instant visual feedback on the results of their action. This rapid feedback can be motivating as students can quickly test their ideas and hypothesis without having manually draw out each transformation. Geogebra can help students develop a stronger grasp of geometric transformations, leading to a greater sense of confidence and competence in their mathematical abilities. This can positively impact learner' s attitudes and motivations toward mathematics.

4.4 Discussion of findings in relation to literature

This study investigate the effects of geogebra in overcoming problems in solving geometrical transformation. The researcher do some lesson with the help of two teachers selected using geogebra and other one using traditional methods. The researcher administer a post-test and pretest. Here are some analysis of the pretest where learners write a one hour test for both groups, the experimental and control group. The pretest was marked out of 20. Table 4.3 show results of pretest and their means, the different between their mean show that geogebra is effective in solving geometrical transformation compared to traditional method because the experimental group mean is 13.5 and for the control group is 10.72. In post-test geogebra have a bigger positive impact on the performance of learners than the traditional method?

According to the study by tarzimi, 2002 and Shukor, 2015, says geogebra is helpful in enhancing learner' s achievement in mathematics. The result is also confirmed by the teachers' responses during the interviews. It was quite conspicuous from the interviews that teachers liked the use of geogebra in lesson planning and presentations. The teachers clearly spelt out the positive impact of the software on learners' performance. The two teachers interviewed

Concurred that the software was very helpful in fighting misconceptions in geometrical transformation among learners. They also indicated that they used the tool quite often during lessons because it motivates learners. A teacher, under the pseudonym Tanaka, one of the interviewees said: use geogebra both lesson planning and presentation of geometrical transformation lessons because the topic requires learners to visualize and manipulate the objects. Since geogebra is free and user friendly, it makes drawings very clear and neat unlike on the

Chalkboard. I would surely recommend it to both mathematics teachers and learners because geometrical transformation problems are solved very fast and comprehensively, and students enjoy the use of geogebra. To them, it' s a new thing. In addition to using the software in the classroom, Tanaka also reiterated that he would not mind recommending the use of this tool to other members teaching mathematics. Tanaka' s responses resonate with Hohenwarter and, Preiner' s (2007) view that geogebra is a mathematics tool which is flexible and that it enhances visualization of mathematical concepts. Shadaan and Eu (2013) study revealed that geogebra improves students' motivation to learn mathematics and that their knowledge retention is sustained for a longer period. Student' s motivation implies that the learners have confidence and self-efficacy (Makamure, 2018). High self-efficacy is important because it signifies engagement and positive regard for school work. The fact that learners in the study did not memorize formulas and geometrical transformation matrices, in the process of learning geometric transformation confirms what Dogan (2010) asserted, that geogebra software encourages higher order thinking skills among learners.

4.5 chapter summary

This chapter presented, analyzed and discussed data which was generated through post-test and pretest. These findings highlight the potential of GeoGebra as an effective tool for enhancing student learning in geometric transformations. The next chapter will summarise the key findings of this study, draw conclusions about the effectiveness of GeoGebra, and offer recommendations for future research and practice in mathematics education.

CHAPTER 5

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.0 Introduction

This research investigate the effectiveness of geogebra in overcoming problems in solving geometrical transformation. The study aimed to explore how geogebra can enhance students understanding and visualization of geometric transformation and identify potential areas for improvement. The findings of this research provides valuable insights for mathematics educators seeking to enhance the teaching and learning of geometry. In this chapter the researcher focus on the summary of the study, the conclusion and recommendations

5.1 Summary of the study

Chapter 1 of the study was the definition of the problem, the background of the study, the statement of the problem, research questions, and the significance of the study, limitations, Delimitations, assumptions and definitions of key terms. Chapter 2 looked at the literature review which provided literature on the effects of geogebra in overcoming problems in solving geometrical transformation. Chapter 3 focuses on the research design, method or tool, sample size and sampling procedure, data analysis procedure, research instruments, study context and description and highlights on presentation of findings. In chapter 4 the researcher looked at data analysis and discussions. In chapter 4 the major findings are as follows

- The use of geogebra is very effective compared to traditional method. It mainly focus on the visualization of transformation problems and it also increases problem solving skills.
- It explore discovery-based learning approach that can foster a sense of curiosity and motivation as students actively investigate the properties of geometrical transformation.
- Geogebra can help students develop a stronger grasp of geometric transformations, leading to a greater sense of confidence and competence in their mathematical abilities

- The results of post-test and pretest shows that geogebra encourages learner to develop a critical thinking skills, logical reasoning and the ability to analyze and solve geometrical problems.
- I would surely recommend Geogebra to both mathematics teachers and learners because geometrical transformation problems are solved very fast and comprehensively, and students enjoy the use of geogebra.

5.2 Conclusions

Geogebra has proven to be a valuable tool for helping students to overcome common issues when learning geometrical transformation. Geogebra allows students to visually see how transformation like translation, reflections, rotation and dilations affects the position and size of shapes. Students can actively manipulate shapes and observe the transformation in real-time. It is an excellent tool for helping students grasp the fundamental concepts and principles underlying geometric transformations. When used effectively it can significantly improve student problem solving abilities and boost critical thinking.

5.3 Recommendations

The study recommends that geogebra be fully utilized in the teaching and learning of geometrical transformation concepts in secondary schools in Zimbabwe, so that learners' performance in this topic can be improved. According to Arienda et al (2016), the success of the geogebra integrated mathematics lessons depends on the teacher knowledge to use the software. Hence, training is necessary for Mathematics teachers so that they become conversant with how the software is used. However, the training can be facilitated by the availability of necessary

infrastructure and computer units. Future research on the impact of geogebra on students' performance can be conducted with a different topic other than geometrical transformation.

5.4 Summary

The focus of this chapter was to conclude from the findings obtained from the study, suggesting recommendations about the found results as well as shedding light on areas that require further research. Thus, the chapter has conclude and suggested recommendations about the found results of the study.

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APPENDICES

APPENDIX 1: LESSON PLANS

SECTION A: LESSON PLAN FOR CONTROL GROUP

Lesson Plan

Name Gwata Boniface k

Topic translation and rotation

Name of school Sandringham high school

Number of pupils 25

Class form 3

Time 7:30-8:15

Lesson objectives

By the end of the lesson student should be able to:

Translate plane figures in a Cartesian plane using translation vectors

Describe fully the translation between given objects and images

Rotate points and plane figures on a Cartesian plane using geometric method

Find the Centre of rotation

Determine the angle of rotation

Assumed knowledge

I assume that most student have are able to visualize and to name any type of transformation.

Anticipated difficulties

They face some difficulties in integration of transformation

Materials:

- Whiteboard or blackboard

- Markers or chalk

- Rulers

- Graph paper

- Pencils

- Compasses

- Protractors

Lesson structure

stage	content	Teacher' s activity	Student activity
Introduction 5mins	Begin the lesson by asking students if they have ever seen or heard of geometric	Asking students if they have heard of geometric transformation Show examples of	Reply to the teacher

	transformations.	everyday objects or images that have been transformed and ask students to identify what type of transformation has occurred	
Step 1 25 mins	Explain the four main types of geometric transformations: translation, rotation, reflection, and dilation. Demonstrate each type of transformation using simple drawings on the whiteboard/blackboard, explaining the rules and characteristics of each.	Explain the four types of transformation Demonstrate each type of transformation	Pay attention to the teacher
Step 2 10 mins	Have students pair up and provide them with a worksheet that includes different shapes and a grid.	Provide a worksheet. Circulate around the room to assist students and provide guidance as needed.	Workout the worksheet in pairs.
Conclusion	Assign additional practice problems from the	Encourage students to explore more complex	Do the assigned work individual

5 mins	textbook	transformations independently.	

Section B: Lesson Plan for the group which use geogebra

Lesson Plan

Name Gwata Boniface k

Topic rotation and translation

Name of school Sandringham high school

Number of pupils 25

Class form 3

Lesson objectives

By the end of the lesson students should be able to:

Use technology tools (geogebra) to explore and visualize geometric transformations.

Translate plane figures in a Cartesian plane using translation vectors

Describe fully the translation between given objects and images

Rotate points and plane figures on a Cartesian plane using geometric method

Find the center of rotation

Determine the angle of rotation

Assumed knowledge

I assume that most student have are able to visualize and to name any type of transformation.

Anticipated difficulties

They face some difficulties in integration of transformation

They are unable to use geogrebra

Materials:

- Whiteboard or blackboard

- Markers or chalk

-computer software (Geogebra)

-internet

Lesson structure

stage	content	Teacher' s activity	Student activity
Introduction 10mins	Introduction of geogebra as a dynamic mathematical software. Using geogebra to construct and manipulate geometric shapes and explore their property	Introduce geogebra as a dynamic mathematical software. Explain how to use geogebra to construct and manipulate shapes	Learn how to use geogebra

Step 1 20 mins	Explain the four main types of geometric transformations: translation, rotation, reflection, and dilation. Demonstrate how to use geogebra on rotation and translation	Explain the four types of transformation Demonstrate how to use geogebra on rotation and translation	Observe how the properties of shape change as they apply transformation
Step 2 10 mins	Have students pair up and provide them with a worksheet that includes different shapes and a grid.	Provide a worksheet. Circulate around the room to assist students and provide guidance as needed.	Describe the transformation and the result changes to the shape.
Conclusion 5 mins	Assign additional practice problems from the textbook	Encourage students to explore more complex transformations independently.	Do the assigned work individual

APENDIX 2: TEST

SECTION A: test plan

Topic transformation

Number of pupils 50

Test Objectives

By the end of the test students should be able to:

Answer any transformation problem

Test instructions

Read all instructions carefully

Answer all question

Use paper, pen, pencil and geometry transformation software (geogebra)

Assumed knowledge

I assume that all students understand the concept of transformation

Stages	content	Teacher activity	Student activity

Introduction 5mins		Read test instruction	Pay attention to instruction.
Stage 1 5 mins	Provision of question papers	Provide question papers and answer sheet	Write their names on answer sheets
Step 2	Writing exam	Walking around the class.	Writing
Step 3	End of test	Taking papers	Give answer papers
Further student activities	Revision	Asking students about the test	Give some feedback to the teacher

Test dossier

By the end of the test student should be able to summaries what they wrote

Test instructions

Answer all questions

Label all points and figures clearly

Show all work and calculations

Use ruler and protract to ensure accuracy

Items pretest

1. Explain the following transformation on a plane

a). Translation (2)

b). Rotation (2)

c). Reflection (2)

d). Scaling (2)

2. Which of the following statements about translation is true

a). A translation preserves angles and length

b). A translation changes the size of an object

c). A translation changes the shape of an object

d). A translation changes the orientation of an object

3. What is the result of a reflection over the x-axis followed by a reflection over the y-axis?

a). A 180 degree rotation

b). A translation

c). A reflection over the line y=x

d). An enlargement or reduction

4. Which of the following statements about rotations is true

a).A rotation changes the size of an object

b). A rotation changes the shape of an object

c).A rotation changes the orientation of an object

d). A rotation preserves angles and lengths

5. What is the result of a dilation with a scale factor of 0.5?

Commented [h1]:

a). An enlargement

b). A reduction

c). A translation

d). A rotation

Specification Grid

Question number	knowledge	understanding	application
1 2 3 4 5			

Marking guide

2. A 180 degree rotation

3. A rotation preserves angles and lengths

4. A reduction

Post-test items

Use a scale of 2 cm to 1 unit on both axes.

A). Triangle PQR has vertices at P (1; 3), Q (2; 1) and R (4; 3)

Draw and label triangle PQR. [6]

(b) Triangle P1Q1R1 is the image of triangle PQR under a reflection in the line y =-x

(I) Draw the line y=-x [4]

(ii) Draw and label triangle P1Q1R1 [6]

(iii) A transformation, G, maps triangle PQR onto triangle P2Q2R2 with vertices at P2 (1;-6), Q2 (2;-2) and R2 (4;-6).

Draw and label triangle P2Q2R2. [4]

(iv) Describe fully the single transformation, G, which maps triangle PQR onto triangle P2Q2R2 [5]

(c) The point R3 (-1; 2) is the image of R under a translation.

(I) find the translation vector. [4]

(ii) Write down the coordinates of P3 and Q3the images of P and Q respectively, under the same Translation. [5]