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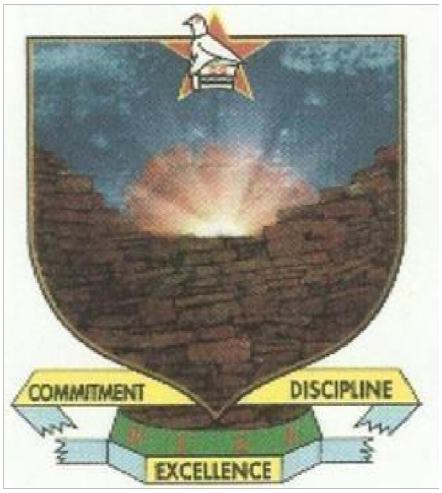

FACULTY OF SCIENCE EDUCATION

INVESTIGATING THE IMPACT OF A STRONG FOUNDATION IN MATHEMATICS ON STUDENTS' PERFORMANCE IN PHYSICS. A CASE STUDY WILL BE CONDUCTED IN CHEGUTU DISTRICT FOCUSING ON THREE SELECTED SCHOOLS.

BY

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REG. NO B1337467

A DISSERTATION SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENTS OF THE BACHELOR OF SCIENCE HONORS DEGREE IN

PHYSICS EDUCATION

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Release Form

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I feel obliged to our almighty God who gave me strength to accomplish this work. I would like to thank my family for all their sacrifices they made for my benefit. I will forever appreciate and be grateful for their steadfast love. I am where I am today because of their support and encouragement.

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DEDICATION

I dedicate wholeheartedly this study to my family for their untiring and impracticable support during hard times encountered and all my colleagues.

ABSTRACT

Physicists utilize mathematics as a powerful tool to answer questions and describe physical phenomena. Mathematics provides the structure for analysis, calculations and reaching scientific conclusions. In addition, math and physics are closely intertwined and connected fields. Mathematics is not just a tool for physicists, it is a fundamental part of the language of physics. The two disciplines are deeply interconnected, with mathematics providing the framework for expressing and understanding the fundamental laws of physics. Learners' mathematical ability correlates with the performance in Physics both at O-level and A-level. The study aimed at exploring the factors that contribute to the difficulties learners face in understanding mathematical and physics concepts and to suggest strategies for improving their performance. To accomplish this, the study addressed the following objectives, how do learners and teachers perceive the teaching and learning of mathematics and physics both at O-level and A-level, what strategies can be

employed to improve the performance of learners in physics. The study has been motivated in identifying the factors that contribute to the poor performance of learners in physics and suggesting strategies for improving their performance. The study adopted a mixed method approach, whereby both qualitative and quantitative methods were utilized to gather data. The population involved science teachers, Ordinary level students, Advanced level students and the heads of science departments in the selected schools who were selected using purposive sampling. Three major categories of factors were identified as contributing to students' low performance in mathematics physics, namely, learning factors, teaching factors, and administrative factors. Learning factors are those factors that emanate from the learners, such as time management skills and background in mathematics; teaching factors are those factors that are attributable to the teacher, such as quality of teacherstudent interactions and teacher's content knowledge; while administrative factors are those factors that can be attributed to the administrative context within the school, such as access to resources and quality of guidance provision. Based on the research findings, a number of recommendations were made to practitioners and policy makers. For the school administrators, it is recommended that mathematical ability be put in preference to ensure that the students' voice is heard and supported during selection of preferred subject combinations. For teachers, it is recommended that the use of practical and interesting learning experiences during lessons be inculcated right from the first year of secondary education so as to engage the learners and sustain their attention.

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CHAPTER 1: INTRODUCTION

1.1 Introduction

This chapter provides an overview of the background of the study, statement of the problem, aim and objectives of the study, significance of the study, delimitation, organization of the study and lastly summary of the chapter.

1.2 Background

One of the key science courses in secondary education is physics, which is also crucial to any country's industrial revolution and advancement of technology. The study of general physical principles and phenomena, their detection, and their interpretation through the use of science is the foundation of physics. Knowing the natural laws is what it is (Chassy & Jones, 2019). Physics difficulties can be more easily incorporated when taught or learned using Mathematics as a guide.

In order to solve both natural and man-made problems in the wider environment, as well as a variety of personal difficulties, scientific understanding in physics is extremely helpful. Mathematics, science, technology, and engineering (STEM) education is an essential component to a country's efforts to progress (Baldwin, de Pomerai & Smith, 2016). Technology and science are viewed as an essential component of a country's productivity and might.

Modern economic expansion, social prosperity, political dominance, and military superiority all appear to be facilitated by technological innovation. This means that physics knowledge contributes to the cognitive reservoir that makes technologically oriented society possible to sustain and grow. Physics connects concepts learned in the classroom with real-world phenomena to applications in engineering and related professions. Physics is essential to all areas of human activity, including geology, computers, petroleum engineering, medicine, pharmacy, and agriculture. Scientific and technological achievements permeate every aspect of human endeavor. It is true

that every aspect of society depends on science and technology to function and that mathematics, being a product of human thought, is the universal language used to characterize issues that arise in the majority of science and technology fields (Chassy, P., & Jones, J, 2019)

Though to differing degrees, Mathematics has a substantial impact on every element of the human world through its generation, analysis, and interpretation of numbers and symbols. A man's life revolves around numbers in all spheres-social, economic, political, geographical, scientific, and technical. Mankind's first civilization emerged through the application of Mathematics. The Egyptian pyramid, built many years ago, continues to draw tourists today. The pyramids were built with careful and astute mathematical computations.

The hyperlink connecting Mathematics and the growth and evolution of the human world attests to its significance. It is more closely associated with the scientific and technological aspects of our world than with any other because of its numerical and symbolic nature. It happens and keeps happening in the natural and physical sciences, which are mostly taught in our secondary schools as physics and chemistry. Based on these circumstances, it is well-established that Mathematics plays a significant role in physics and chemistry student performance, and that Mathematics is the control tool that underpins all scientific and technological abilities. In terms of using numbers and numeration fractions, logarithm indices, algebraic methods for solving equations, variation, and graph plotting, Mathematics is a topic related to other sciences like chemistry and physics. Nonetheless, volume students frequently score poorly in the sciences (Chassy, P., & Jones, J, 2019).

Today, science pervades literally every field of human endeavor and plays a fundamental role in the teaching and learning process. However, the issue remains that in most, schools in Zimbabwe, there is high rate of failure in the subject. From the past six years the performance pass rate of learners at Ordinary Level in Physics

deteriorated from 75.5% to 67.5%. The table below show how pass rate varies from 2015 to 2023 for A level Physics.

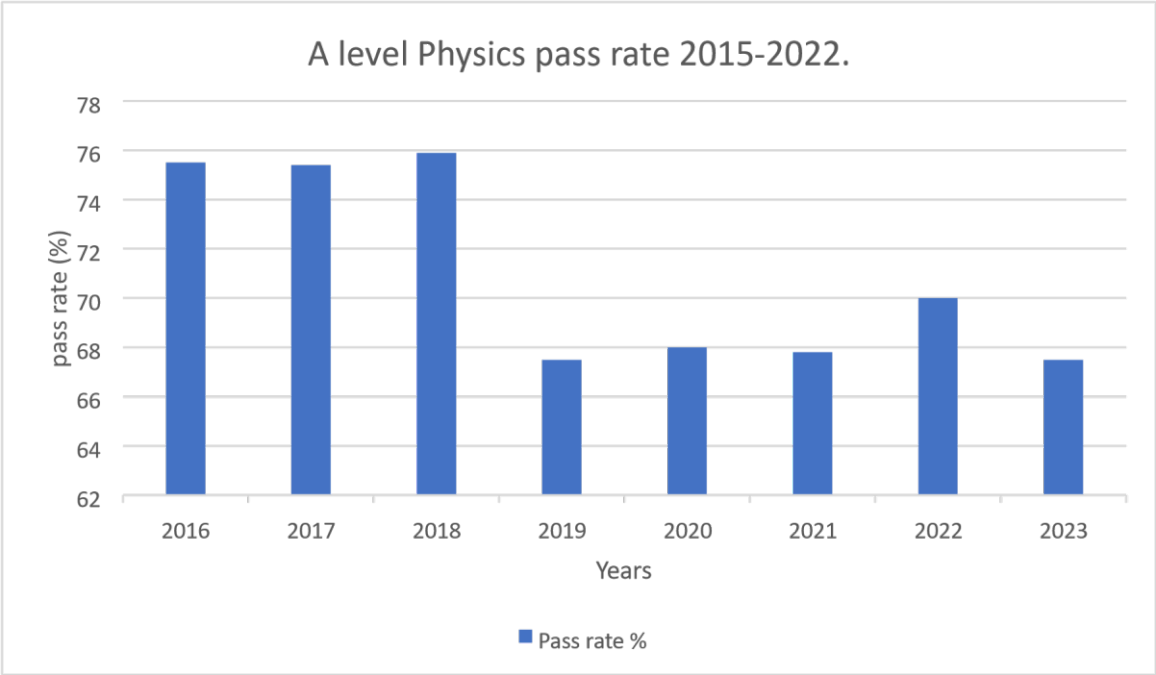


Figure 1.1: Graph of A level Physics pass rate 2016-2023

The graph above shows a drop of pass rate from 2016 to 2023 in the subject. From 2016-2018 there was a slight change on the pass rate, but dropped drastically for the other 5years though there is a minimum increase. (Charles-Organ, 2017) carried out an investigation on causes of poor performance in physics due to lack of strong foundation of Mathematics and concluded that so many Physics students struggle with learning basic Mathematics. Nevertheless, many people—including students—still believe that Mathematics is not as vital for performing well in science, despite the fact that it is the cornerstone of scientific advancement. The disagreement surrounding Mathematics' nature can be blamed for this (Hailikari et al., 2017), *and the question of which field of science Mathematics belongs in still has to be clarified. Although there is a general consensus that Mathematics must*

be a science, there is also a counterargument that asserts Mathematics must be an art. Taking into account the "arts" side of the debate, which focuses on its application and claims that it is only art.

Furthermore, other pupils believe that Mathematics is difficult, and they attempt to steer clear of it. Even when a teacher teaches two or more of the physical sciences—physics, chemistry, and Mathematics—they are studied as distinct topics in our secondary schools with little to no direct relationship to one another. It is impossible to comprehend the interdependence of the many sciences (Mathematics and physics) without integration, deliberate planning, and coordination. As a result, the study's main objective is to examine how a student's mathematical background affects their physics coursework.

The majority of pupils in the Chegutu district don't appear to comprehend how physics and Mathematics are related to one another. In Chegutu district schools, science and Mathematics have similar goals, and specializing in science is advised for improved academic performance. It is necessary to have Mathematics as a minor prerequisite. Because they are intimately tied to Mathematics, physical sciences have a strong mathematical foundation.

1.3 Problem statement

Students who receive poor instruction or none at all regarding the hyperlinks between these courses come to realize that Mathematics is not essential to excel in Physics. However, admission to the majority of local universities requires completion of Physics. Furthermore, subsequent patterns in the pupils' performance in Physics in Chegutu district demonstrate students do not know how to apply their mathematical knowledge to Physics, to a particular problem circumstance or lack the necessary mathematical skills to solve Physics problems.

Aside from the benefits and respect physics has as one of the fundamental sciences and as the foundation for economic and technological advancement, there is still

disconnection between the design and execution of curricula and their intended outcomes. All of these factors combined to give pupils a bad impression of Physics as a discipline.

1.4 Aim and objectives

The primary goal of the research is to investigate how students' academic performance in Physics in Chegutu District Schools is impacted by their background in Mathematics.

Objectives of the study are as follows:

- To distribute questionnaires in viewing the learner’s correlation of Math and Physics.
- To apply the cognitive tools involved in solving Mathematics problems in Physics.
- Constructing graphs to show the performance of students with and without the strong background in Mathematics.

1.5 Significance of the study

The study's significance lies in identifying the correlation of knowledge in Mathematics and Physics. The factors that contribute to the poor performance of learners in physics due to correlation in mathematical ability of the learners and suggesting strategies for improving their performance. The findings of the study have implications for teaching and learning practices in Physics education. The study provides insights into the challenges that learners face when learning mathematical concepts and highlights the importance of addressing these challenges to improve learners' understanding and performance in Physics. The results of this study suggest possible solutions to make science teaching and learning more meaningful to learners and teachers. The study further aims at suggesting ways to eliminate problems which continue to detract from the learner's performance in Mathematics both at Ordinary level and Advanced level, in Chegutu district. Bridging the gap between curriculum development and pertinent implementation within the framework of the curriculum intentions, the study will support teachers. This will effectively create a web of connections between the disciplines, enhancing the student's performance in Physics through mathematics relation, in Chegutu district schools.

1.6 Delimitation of the study

This study looks at how students in Chegutu district schools fare academically in Physics when they lack a strong Mathematics foundation as their results in Physics were recorded lower than other districts. The three schools on which the study focuses are Sandringham High School, St. Eric's High School, and Vimbai High School. The study's methodology involved tracking changes in students' academic achievement on a randomly selected number of Mathematics-related topics, including linear space, quantum field theory, and dynamical systems. A map is attached on the appendix to indicate the location of the three selected schools in Chegutu district.

1.8 Organization of the study

This research study explores the reason behind the poor performance of Physics due to lack of Mathematics background. The first chapter concentrated on introducing the main aim of the study, the second chapter focus on the literature review behind the study the third chapter concentrated on the research methodology used by this study, fourth chapter focuses on data presentation, analysis and interpretation and the last chapter focuses on summary, conclusion and recommendation made during the study.

1.9 Summary

This chapter reviewed earlier research conducted by scholars worldwide, demonstrating how a strong foundation in Mathematics is a critical prerequisite for students' academic performance to be on the rise in Physics. Reasonable conclusions have been removed, however in other parts of Zimbabwe, like the Chegutu district high schools, there have been doubts raised about things like "are the teachers really applying physics teaching with sufficient, appropriate equipment, and are they fully complying with the effective emphasis of the physics curriculum"? .Do students not know how to apply their mathematical knowledge of Physics to a particular problem circumstance, or do they lack the necessary mathematical skills to solve Physics problems? These inquiries sparked concerns about Zimbabwe's physics and math correlation.

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

Mathematics is integral to topics such as mechanics, electricity and quantum physics. It is often used to derive and understand the mathematical relationships that govern physical phenomena. Additionally, the proficiency in Mathematics is often a requirement for pursuing further studies or careers in Physics-related fields. For instance, many universities and colleges require a certain level of mathematical proficiency for admission to physics or engineering programs. Despite its importance, learners often struggle to understand and apply the principles of mathematics when studying Physics. This literature review devotes itself to presenting the existing international, national and regional literatures in the arena of factors that influence learners' poor performance in Physics due to a compromised Mathematical background.

2.2 Factors affecting learner performance

Three factors have been identified as main contribution to learners' poor performance in physics. These factors include geographical, instructional and individual factors.

2.2.1 Geographical factors

Several geographical factors contribute to learners' poor performance in physics. This factor includes gender, socio- economic status and parents' educational level to mention but a few.

2.2.1.1 Gender

Many variables have long been studied as predictors of Mathematics achievement. However, gender issues on math achievement are studied most frequently by researchers. For instance, a study through a meta-analysis reveals that males tend to do better on Mathematics tests that involve problem-solving (Charles-Ogan, 2017). Females tend to do better in computation, and there is no significant gender difference in understanding math concepts. Another study shows that females tend to earn better grades than males in Mathematics (Chasy,P . & Jones, J., 2019).

Some recent studies have revealed that gender differences in Mathematics education seem to be narrowing in many countries. However, studies indicate that as students reach higher grades, gender differences favor increase in math achievement by males (Charles-Ogan, 2017). For instance, the results from the Third International Mathematics and Science Study showed that Mathematics achievement scores of each gender group were close to each other at the primary and middle school year (Chasy,P . & Jones, J., 2019). However, in the final year of secondary school, evidence was found for gender differences in Mathematics achievement. Another study, which was conducted to analyze factors that affect math achievement of 11thgraders in math classes with an identified gender gap, also showed that males scored higher than females on 11th grade math achievement test, but this difference decreased from 10th grade (Akinsola, M.K. & Awofala, A.O.A , 2021)

In addition, gender differences in attitudes and perceptions of the usefulness of

Mathematics for middle school students were found statistically important (CharlesOrgan, 1., & 1. F., Okey , 2017). For example, female students show less interest in Mathematics and have negative attitude toward Mathematics. It is also reported that girls tend to learn mathematical concepts by means of rules or cooperative activities, while boys have a tendency to be in a competition to master mathematical concepts (Reddy, M.V.B. & Panacharoensawad, B., 2017)

The literature on gender differences provides evidences that gender issues impact achievement in Mathematics. Hence, it is crucial for educators and researchers to pay attention to gender differences in the design of Mathematics instruction.

2.2.1.2 Socio-Economic Status

Socio-economic status is determined to be a predictor of Mathematics achievement. Studies repeatedly discovered that the parents' annual level of income is correlated with students' math achievement scores. Socio-economic status was found significant in primary math and science achievement scores (Ma & Klinger, 2018). Another study found poor academic achievement of Canadian students to be attributable to their low socio-economic status. Socio-economic status was examined and found to be one of the four most important predictors of discrepancy in academic achievement of Canadian students (aged 15) in reading, Mathematics, and science by the Program for International Student Assessment (Human Resources Development Canada, Statistics Canada, & Council of Ministers of Education Canada, 2020).

A number of studies showed that parents with higher socio-economic status are more involved in their children's education than parents of lower socio-economic status. This greater involvement results in development of positive attitudes of children toward school, classes, and enhancement of academic achievement (Adetutu, 2020). It is believed that low socio-economic status negatively influences academic achievement, in part, because it prevents students from accessing various educational materials and resources, and creates a distressing atmosphere at home possible disruptions in parenting or an increased likelihood family conflict (Charles-Organ,

1., & 1. F., Okey , 2017). For these reasons, socio-economic status of a student is a common factor that determines academic achievement.

2.2.1.3 Parents' Educational Level

Parents' educational level has been shown to be a factor in academic achievement. Parents serve as a role model and a guide in encouraging their children to pursue high educational goals and desires by establishing the educational resources on hand in the home and holding particular attitudes and values towards their children's learning. In this case, the educational attainment of parents serve as an indicator of attitudes and values which parents use to create a home environment that can affect children's learning and achievement.

A number of studies indicated that student achievement is correlated highly with the educational attainment of parents (Chasy,P . & Jones, J., 2019). For instance, students whose parents had less than high school education obtained lower grades in Mathematics than those whose parents had higher levels of education. Research has shown that parents' educational level not only impact student attitudes toward learning but also impact their math achievement scores.

2.2.2 Instructional Factors

Mathematics plays a significant role in Physics particularly at both at O level and A level, where a strong foundation in Mathematics is essential for understanding advanced Physics concepts and solving mathematical problems related to Physics. Developing critical thinking and analytical skills is important for understanding and interpreting complex physical phenomena and theories.

Instructional factors are also key when it comes to Mathematics understanding improving performance in Physics. Also, with the increased use of ICT in classrooms

but the “no significant difference” findings various research studies have found, it is important for research to contribute to the design of ICT-infused learning environments that would result in significant improvements in learning outcomes. From a practical perspective, the research study contributes to schools in Chegutu district, by sharing the design and practice of an intervention that led to significant improvements in students' learning outcomes, both from cognitive and affective fronts.

2.2.2.1 Curriculum

Many concerns have been emphasized in the literature about the existing math curricula that emphasize not so much a form of thinking as a substitute for thinking. The process of calculation or computation only involves the deployment of a set routine with no room for ingenuity or flair, no place for guess work or surprise, no chance for discovery, no need for the human being, in fact (Reddy, M.V.B. & Panacharoensawad, B., 2017).

The concerns here are not that students should never learn to compute, but that students must learn how to critically analyze mathematical problems and produce effective solutions. This requires them to learn, how to make sense of complex math concepts and how to think mathematic (Akinsola, M.K. & Awofala, A.O.A , 2021). Many Mathematics curricula overemphasize memorization of facts and underemphasize understanding and application of these facts to discover, make connections, and test math concepts. Memorization must be raised to conceptualization, application and problem-solving for students to successfully apply what they learn. An impressive body of research suggests that curriculum that considers students to be incapable of metacognitive actions (e.g., complex reasoning) should be replaced with the one that sees students who are capable of higher-order thinking and reasoning when supported with necessary and relevant knowledge and activities (Jufrida, J., Kurniawan, W., Astalini, A., Darmaji, D., Kurniawan, D. A., & Mava, W.A, 2019). Research has also revealed evidence that curricula in which

students' knowledge and skills grow is significantly connected to their learning, and therefore their achievement.

2.2.2.2Instructional Strategies and Methods

Being successful in math involves the ability to understanding one's current state of knowledge, build on it, improve it, and make changes or decisions in the face of conflicts. To do this requires problem solving, abstracting, inventing, and proving (Romberg, 2020). These are fundamental cognitive operations that students need to develop and use it in math classes. Therefore, instructional strategies and methods that provide students with learning situations where they can develop and apply higher-order operations are critical for Mathematics achievement.

In the literature, it is pointed out that for students to accomplish learning, teachers should provide meaningful and authentic learning activities to enable students to construct their understanding and knowledge of this subject domain (Wilson, 2018). In addition, it is emphasized that instructional strategies where students actively participate in their own learning is critical for success (Bloom, B. 2017). Instructional strategies shape the progress of students' learning and accomplishment. **2.2.2.3 Teacher Competency in Math Education**

Many studies report that what teachers know and believe about Mathematics is directly connected to their instructional choices and proceed National Council of Teachers of Mathematics also reported that in Mathematics education research, it seems to be undisputed that the teacher's philosophy of Mathematics has a significant influence on the structure of Mathematics classes. Teachers need to have skills and knowledge to apply their philosophy of teaching and instructional decisions (Andrade, 2019) .

In the 21st century, one shifting paradigm in education is about teachers' roles and competencies. Findings from research on teacher competency point out that if teachers are to prepare an ever more diverse group of students for much more challenging work--for framing problems; finding, integrating and synthesizing information; creating new solutions; learning on their own; and working cooperatively--they will need substantially more knowledge and radically different

skills than most now have and most schools of education now develop (Adetutu, 2020) .

Teachers not only need knowledge of a particular subject matter but also need to have pedagogical knowledge and knowledge of their students (Bransford 2020).

Teacher competency in these areas is closely linked to student thinking, understanding and learning in math education. There is no doubt that student achievement in math education requires teachers to have a firm understanding of the subject domain and the epistemology that guides math education as well as an equally meticulous understanding of different kinds of instructional activities that promote student achievement. Competent math teachers provide a roadmap to guide students to an organized understanding of mathematical concepts, to reflective learning, to critical thinking, and ultimately to mathematical achievement.

2.2.24 School Context and Facilities

School context and its facilities could be an important factor in student achievement. In fact, identifying factors related to the school environment has become a research focus among educational practitioners. For instance, research suggests that student achievement is associated with a safe and orderly school climate. Researchers also found a negative impact on student achievement where deficiencies of school features or components such as temperature, lighting, and age exist. In a study by (Adetutu, 2020), temperatures above 23° C (74° F) adversely affected Mathematics skills. In terms of the condition of school building, Cash found student achievement scores in standard buildings to be lower than the scores of students in above standard buildings. In addition, (Jufrida, J., Kurniawan, W., Astalini, A., Darmaji, D., Kurniawan, D. A., & Mava, W.A, 2019) conducted multiple regression statistical analysis to examine the relationship between overcrowded school buildings and student achievement. The findings indicated that a high population of students had a negative effect on student achievement.

2.2.3 Individual Factors

Subjectivity is one of the uniqueness that learners possess. It is a human trait that cuts across all divides. The teaching and learning process between science teachers and learners is very unique. Teachers has to employ various

2.2.3.1 Self-Directed Learning

Self-directed learning could be a factor in students' math achievement. Mathematics learning requires a deep understanding of mathematical concepts, the ability to make connections between them, and produce effective solutions to ill-structured domains. There is no perfect, well-structured, planned or prescribed system that lets students think and act mathematically. This can be done if, and only if, students play their assigned roles in their learning progress. Self-directed learning has an important place in successful math learning. Self-directed students can take the initiative in their learning by diagnosing their needs, formulating goals, identifying resources for learning, and evaluating or monitoring learning outcomes. The teacher's role is to engage students by helping to organize and assist them as they take the initiative in their own self-directed explorations, instead of directing their learning autocratically (Adetutu, 2020).

2.2.3. 2 Arithmetic Ability

Arithmetic ability could also be another predictor of math achievement. Arithmetic ability includes the skills such as manipulating mathematical knowledge and concepts in ways that transform their meaning and implications. It allows students to interpret, analyze, synthesize, generalize, or hypothesize the facts and ideas of Mathematics. Students with high arithmetic ability or mathematical reasoning can engage in tasks such as solving complex problems, discovering new meanings and understanding, and arriving at logical conclusions.

Arithmetic ability was determined by various studies as a critical factor on students' math achievement. For instance, (Andrade, 2019), arithmetic ability gave the highest correlation coefficient with Mathematics achievement. Similarly, student achievement scores were found to be most strongly predicted by level of ability (Charles-Organ, 1., & 1. F., Okey, 2017). Some other researchers have also investigated the relationship of gender issues and arithmetic ability on math achievement. For instance, (Reddy, M.V.B. & Panacharoensawad, B., 2017) conducted a study to investigate longitudinal data gathered over 10 years with an aim at asking whether personality traits were related to gender differences in long-term achievement in Mathematics and the sciences. The study revealed that math ability was the most significant predictor of long-term achievement in math for young women. However, the level of math ability did not seem to be a factor of long-term math achievement for young men.

2.2.3.3 Motivation or Concentration

Mathematics education requires highly motivated students because it requires reasoning, making interpretations, and solving problems, mathematical issues, and concepts. The challenges of Mathematics learning for today's education is that it requires disciplined study, concentration and motivation. To meet these challenges, learners must be focused and motivated to progress. (Simpson, 2019) examined the relationship between classroom motivation and academic achievement in elementary-school-aged children (122-first grade and 129-third grade participants). Consistent with previous studies, they found that for a higher level of mastery, motivation was related to higher math grades (Reddy, M.V.B. & Panacharoensawad, B., 2017).

The teacher's role in students' motivation to learn should not be underestimated. In helping students become motivated l (Andrade, 2019)earners and producers of mathematical knowledge successfully, the teacher's main instructional task is to create a learning environment where students can engage in mathematical thinking activities and see Mathematics as something requiring "exploration, conjecture, representation, generalization, verification, and reflection" (Charles-Ogan, 2017).

In spite of all the advantages derived and the recognition given to physics as one of the core science subjects and as a pivot upon which technological and economic development rest, there are wider gaps between curriculum planner intention, the implementers, that is, physics classroom teachers and what goes on in the classroom. This has led to the negative perception of students that physics is a difficult school subject. More often than not the interrelatedness of Mathematics and physics is not always emphasized in physics teaching

2.3 Summary

Knowing and understanding the opinions of math students is important to identify factors they perceive to be effective for achievement in Mathematics. Findings of this study revealed three factors that contribute to Mathematics achievement: instructional strategies and methods, teacher competency in math education, and motivation or concentration. Further investigation of these three factors, through experimental studies, should enable the investigator and math educators to continue to improve Mathematics instruction.

CHAPTER 3: RESEARCH METHODOLOGY 3.1. Introduction

This chapter identified the techniques and procedures to be adopted in conducting the study. It explained the research design, the study site and population, the sample size and sampling technique, the procedures of data collection, the data gathering tools, the methods of data analysis and Ethical considerations.

3.2 Research design

Triangulation research design was adopted in this study. The purpose of this design is to obtain different but complementary data on the same topic to best understand the research problem (Doris, 2019). The research both use qualitative and quantitative research approaches. The method allows direct interaction between the researcher and the participants .In order to directly compare and contrast quantitative statistical results with qualitative findings or to validate or expand quantitative results with qualitative data the researcher adopted the design. The Triangulation Design is a one-phase design in which researchers implement the quantitative and qualitative methods during the same timeframe and with equal weight. The single-phase timing of this design is the reason it has also been referred to as the "concurrent triangulation design" (Chassy, P., and Jones, J. , 2019). It generally involves the concurrent, but separate, collection and analysis of quantitative and qualitative data so that the research problem may best understood. The study attempts to merge the two data sets, typically by bringing the separate results together in the interpretation or by transforming data to facilitate integrating the two data types during the analysis.

3.3 Research paradigm

This study employs a mixed method methodology. (Andrade, 2019), a mixed method research design is a research design that has its own philosophical assumptions and methods of inquiry. As a methodology, it includes philosophical assumptions to provide directions for the collection and analysis of data from multiple sources in a single study. A mixed-methods design offers a number of benefits to approaching complex research issues as it integrates philosophical frameworks of both post-positivism and interpretivist (Adetutu, 2020) interweaving qualitative and quantitative data in such a way that research issues are meaningfully explained. It also offers a logical ground,

methodological flexibility and an in-depth understanding of smaller cases (Doris, 2019). In other words, the use of mixed-methods enables researchers to answer research questions with sufficient depth and breadth (Jufrida, J., Kurniawan, W., Astalini, A., Darmaji, D., Kurniawan, D. A., & Mava, W.A, 2019)and helps generalize findings and implications of the researched issues to the whole population. For example, the quantitative approach helps a researcher to collect the data from a large number of participants; thus, increasing the possibility to generalize the findings to a wider population. The qualitative approach, on the other hand, provides a deeper understanding of the issue being investigated, honoring the voices of its participants. In other words, whereas quantitative data bring breadth to the study and qualitative data provides depth to it. Moreover, quantitative results can be triangulated with qualitative findings and vice versa. Triangulation, as a qualitative research strategy, is the use of multiple methods or data sources to develop a comprehensive understanding of a research problem or to test validity through the convergence of information from different sources (Akinsola, M.K. & Awofala, A.O.A , 2021). A mixed-methods design, therefore, offers the best chance of answering research questions by combining two sets of strengths while compensating at the same time for the weaknesses of each method. Consequently, "mixed-method research designs are becoming increasingly relevant to addressing impact research questions" (Charles-Organ, 2017).

3.4 Research methods

3.4.1 Targeted population

The participant schools were drawn from three schools; Vimbai secondary school, St. Eric's secondary school, Sandringham secondary school, which were selected through random sampling taking into consideration the availability of science laboratories and other learning materials in these schools. The population included the A level and O Level students following the Zimbabwean national curriculum.

Schools in Chegutu district is shown on a map in the Appendix section.

3.4.2 Sample

The study population involved science teachers, Advanced level students, O level students and the heads of science departments in the selected schools as shown in Fig 3;

Name of school	Number of A Level students		Number of O level students	
	Boys	Girls	Boys	Girls
St Erick's	5	3	5	3
Vimbai	4	2	10	10
Sandringham	6	6	7	8
Total	15	11	22	21

Figure 2: Sample Size

Chegutu district has a total of 107 Secondary schools. The selected students were involved in this research through answering a questionnaire. The science teachers and the heads of science departments from these schools answered a questionnaire and the heads of science departments were interviewed.

3.4.3 Sampling method

The study employed purposive sampling technique for its convenience as it saved time, labour and affordable as there is no cost for searching for informants. The technique also afforded the study a chance to select key resourceful informants for the study. The sampling method was used in selecting students as well as teachers. Students were selected those who admit to have challenges in physics and math and teachers were those who have experience of about five in the field teaching the subject.

3.4.4 Data collection methods

This study employed two major tools to collect the relevant data; structured interviews and questionnaires; science teachers and heads of science departments of the three selected schools were interviewed while the students answered the questionnaires and also interviewed in focus groups.

3.4.4.1 Questionnaire

Questionnaires were prepared for the participants to collect data on the students and teachers' feelings towards the causes of poor performance and reasons that contribute towards the poor performance in the science subjects. Questionnaires were preferred since they are not time consuming and are easy to administer to a large population. They also simplified the task of categorizing, tabulating and summarizing reactions or responses from the respondents. Questionnaires contained both open ended items and closed ended ones (Likert type items).

3.4.4.2 Interviews

A structured interview is essentially a questionnaire which is mediated or administered. In this study the structured interview was used to increase response rates and to help to get an in-depth understanding of the student's responses in the questionnaires. Interview schedules were

conducted with the participants of the sample group. This helped the study to determine the motivation level that makes students select for science subjects instead of other art related subjects.

This study aimed at interviewing science teachers and heads of science departments of the selected secondary schools within the municipality. The aim of these interviews was to establish the main cause of poor performance of science subjects and get their views regarding what should done in order to improve the performance. Some of the advantages of interviews are; they enabled the study to obtain useful information about personal feelings, Perceptions and opinions, they also gave room for more detailed questions to be asked, they enhanced a high respond rate, the respondents' own words were recorded, and it was easy to clarify ambiguities and follow the incomplete answers. The disadvantages include; they at time consume a lot of time; setting up interviewing, feedback and reporting is a long process, they tend to be costly and the interviewer may understand and translate the interview in a different way.

3.5 Reliability and validity

Reliability and validity are two essential concepts in research methodology that ensure the accuracy, consistency, and credibility of research findings (Reddy, M.V.B. & Panacharoensawad, B., 2017).

Reliability which is the consistency and stability of measurements or data collection procedures (Heali, 2019). A reliable research study produces consistent results when the same measurements are repeated under similar conditions. It ensures that the findings are not influenced by random errors or fluctuations. Researchers strive to achieve high reliability by using reliable measurement tools, employing standardized protocols, and ensuring consistent data collection procedures. High reliability enhances the confidence in the study's results and allows for meaningful comparisons and generalizations. Validity, on the other hand, refers to the accuracy and truthfulness of the research findings (Twycross, 2019). It ensures that the study measures what it intends to measure and accurately represents the phenomenon under investigation. Validity is crucial in ensuring that the conclusions drawn from the research are sound and trustworthy. Researchers employ various strategies to establish validity, such as using appropriate measurement instruments, conducting thorough pilot testing, and employing rigorous research designs. By ensuring validity, researchers can confidently draw meaningful conclusions and make accurate inferences based on their findings.

Both reliability and validity are interconnected and mutually reinforcing. A study can be reliable but lack validity if it consistently measures the wrong thing. Conversely, a study may have high validity but lack reliability if the measurements produce inconsistent results. Therefore, researchers need to address both reliability and validity concerns to ensure the robustness and credibility of their research findings.

3.5.1 Pilot study

Instruments such as questionnaires and interviews need to be tested before being administered on the real respondents. This is done to avoid errors, ambiguities as well as to test one's instruments whether

or not they are understandable. Cresswel (2017) asserts that a pilot study is a small-scale preliminary study conducted before the main study. According to David and Dodd (2015) a pilot study is a smallscale preliminary study conducted before the main research in order to check the flexibility to improve the design of the research. Bell and Bryman (2017) define it as a small study to test research protocols, data collection instruments, sample recruitment strategies, and other research techniques in preparation for a larger study and is one of the important stages in a research project. Therefore, pilot study is a smallscale trial prior to the main survey that tests the entire question planning. Pilot study is crucial element of a good study design, is conducted to evaluate the feasibility of some crucial components of the full-scale study and to identify potential problem areas. The process of pretesting data collection instruments will help researcher to rephrase some questions which were ambiguous.

3.5.2 Reliability of data

Reliability is the degree to which an assessment tool produces stable and constant results. The idea behind reliability is that any significant results must be more than a one off finding and be inherently repeatable. Other researchers must be able to perform exactly the same experiment under the same conditions and generate the same results (Doris, 2019). While reliability is necessary, it alone is not sufficient. For a study or a test to be reliable it also needs to be valid.

3.5.3 Validity of data

Validity refers to the measure of the accuracy and reliability of information within a dataset. Validity encompasses the entire experimental concept and establishes whether the results obtained meet all the requirements of the scientific research method. To test the reliability and validity of the data, the same questionnaires were taken

to other three selected schools, outside the research area. The students and teachers filled the questionnaires and the results were compared to ensure that the results were replicable if applied elsewhere. This was in order to ensure that there is consistency with the results if a similar methodology is used elsewhere. The three schools were; St Paul's secondary school, Chikwaka secondary school Goromonzi secondary.

3.6 Ethical issues

This study was done within the demesnes of principles of research. Proper permission was sought from all interested stakeholders before conducting the study. The Ministry of Primary and Secondary Education, as well as the head of schools where the study was done, settled permission to carry out the study. (Andrade, 2019) Defines ethics as what is morally good and bad behavior. This study dealt with people in both quantitative and qualitative approaches, and as a result, the study exhibited some high morality. It prioritized the following ethical considerations: anonymity and confidentiality, voluntary participation, as well as. Informed consent.

3.6.1 Anonymity and Confidentiality

Both confidentiality and anonymity were not misjudged in this study. Bell (2019) submits that the participants need not to be told or indicate which responses they should give. Thus, on the questionnaire that was availed to teachers, there was no space for them to write names, credentials, or any identification features. The study also maintained high secrecy, by assuring respondents that their responses were solely applied in the educational domain. This gave the respondents vast freedom to expound their feelings.

3.6.2 Voluntary Participation

Before participating on this study, the respondents were notified that contribution was entirely voluntary, and there were no retaliations to

those subjects who were reluctant to continue participating in the study halfway. This means that, participation in this study was not by coercive force, as individuals did it on their own volition. This gave the respondents a greater opening to express their inner feelings, as they participated with free will.

3.6.3 Informed Consent

Informed consent refers to the revelation of the purpose, aims, as well as the study objectives to the participants by the study (McMillan and Schumacher, 2017). Additionally, the participants of this study signed a consent form, explaining all the details pertaining to the relevance of the study to various stakeholders. This inevitably enabled the participants to feel valued, and to proffer authentic and credible information.

3.7 Chapter summary

The chapter has addressed the methodology aspect of the study that included qualitative and quantitative paradigm, descriptive case study, data collection namely questionnaire, target population, sampling methods, data analysis and ethical considerations were also probed.

AND

CHAPTER 4: DATA PRESENTATION, ANALYSIS INTERPRETATION.

4.1 Introduction

This chapter focused on the investigation of how students' academic performance in physics in Chegutu District Schools is impacted by their background in mathematics. Data collected using research instruments was analyzed and the summary presented in this chapter. The analyzed data was interpreted, discussed and presented in this chapter. The variables as isolated from instruments were: the impacts of mathematical ability in teaching and learning of physics, extent of technology use in teaching and learning of physics, teachers' and students' attitude towards use of mathematical concepts in teaching and learning of physics.

The qualitative and quantitative instruments sought to assess the impacts of mathematical background in teaching and learning of physics, establish the attitude of physics teachers and students towards the use of mathematics in teaching and learning of physics, investigate the extent of management and technical support given to physics teachers in use of mathematical concepts, establish physics teachers' mathematical competence in integrating Mathematics in instruction and identify factors influencing use of Mathematics in the teaching and learning of Physics.

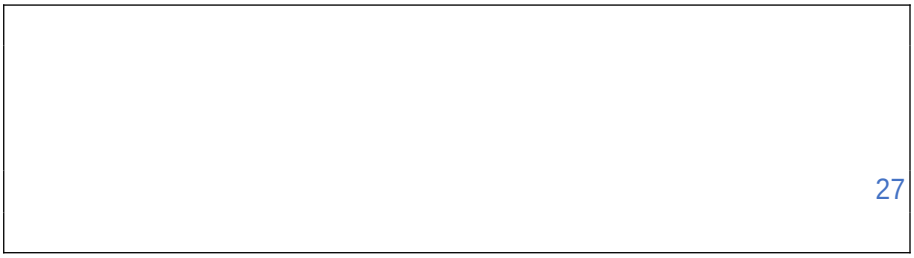

27

Figure 4.2. Distribution of Science teachers by responsibility.

The results indicated that the 70% of the science teachers at the school three schools were mainly O level science teachers, reflecting a huge number of staff and science subjects' classes at O level. Advanced level science teachers were 15%, this showed that a lot of science students are not able to take up science subjects due to a low pass rate a O level. 10% were heads of science departments. The number of administrators is 5%. This clearly exhibits the lack of science teachers with a scientific background holding positions of influence and decision making at the sampled schools in the district of Chegutu, (see figure 4.1). This ratio is a reflection of the distribution of science teachers at these various institutions and how they are positioned in the pursuit of promoting science subjects in the district of Chegutu.

Figure 4.2

4.2.1 Professional qualification

Information on Science teachers' professional qualification was obtained through the questionnaire among the teachers.

Figure 4.2: Professional Qualification of Science Teachers

Figure 4.2

Qualification	frequency	Percentage %
Diploma	7	58.3
Bachelor's degree	2	16.7
Masters	3	25

This study showed that all Science teachers at the school are professionally qualified with, 58.3% ,16.7% and 25% having a Diploma, Bachelors and Masters Degrees respectively. This is an important aspect since according to Allison (2007), skilled and knowledgeable workforce is closely linked with successful implementation of technology. This clearly exhibits that the staff is academically equipped in the teaching and learning of science subjects. The greater number of Diploma holders also shows that there is need for staff development in acquiring Bachelor's Degrees.

4.2.2 Teaching experience

Teachers' teaching experience was considered in a range of five years.

This information was obtained using a questionnaire. Table 4.3 shows

a summary of the teaching experience of the teachers who took part in the study.

Figure 4.3: Teaching Experience in Years

Figure 4.3

Teaching experience	Frequency	%
Below 5 years	6	50
Between 5-9	4	33.3
Between10-14	1	8.3
15 and above	1	8.3
Total	12	99.9

The results showed that the majority of the teachers have a working experience of less than five years. Long experience of teaching a particular subject is important because it could contribute to good content mastery as well as proper use of technological materials by the teacher.

Teachers were asked to indicate their experience in the teaching and learning of science subjects in one form or another. The findings are summarized in table 4.4.

Figure 4.4 Science Teachers' Experience in teaching Physics and Mathematics

Figure 4.4

Experience in teaching mathematics and physics	Frequency	%
Below 5 years	5	41.67
Between 5-9	3	25
Between10-14	2	16.67
15 and above	2	16.67
Total	12	100

The study showed that only 41.67% of the teachers in the study sample have been teaching maths and physics for less than 5 years. This can be a factor in the low pass rate in physics in Chegutu district as their experience is still limited. 25% in between 5 to 9 years. 16.67% between 10 and 14 years as well as 15 years and above respectively.

4.1.4 Ordinary and Advanced Level Students.

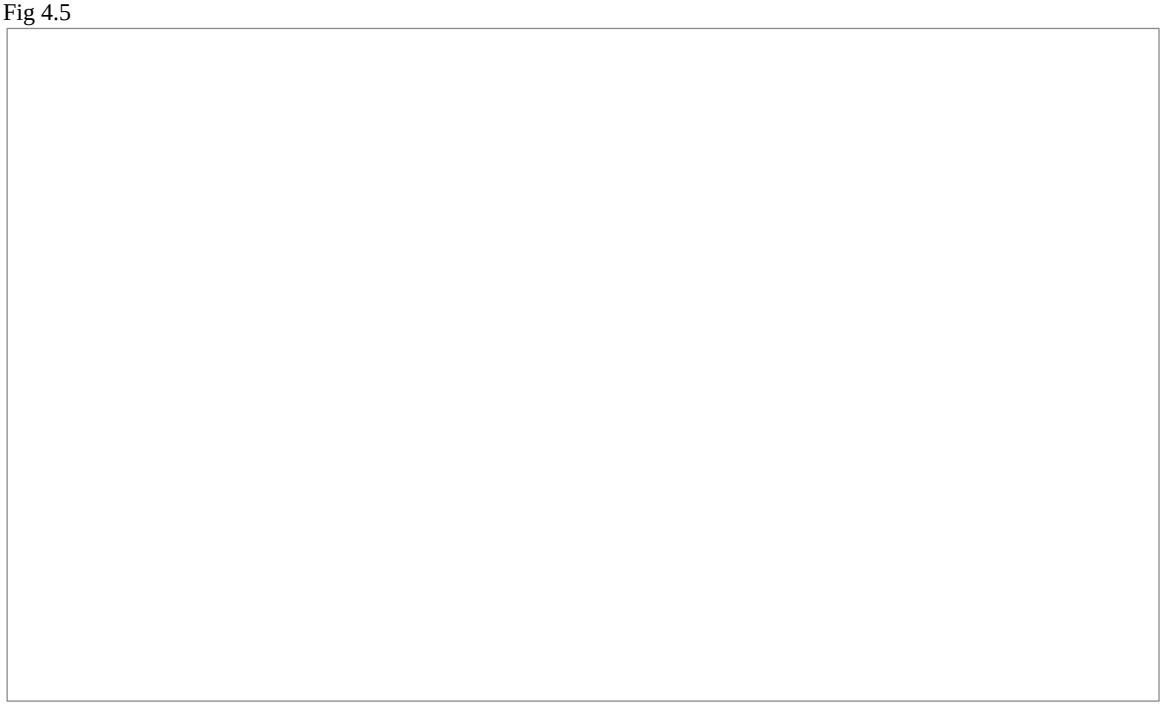
As indicated earlier, the main focus of this study was the students. This formed a total of 69 students from Sandringham, Vimbai and St Ericks.

4.1.5. Ordinary Level and A level students by gender

A total of 37 students from the three schools responded to Questionnaire. Figure 4 shows their distribution by gender.

Fig 4.5 Distribution by gender

Fig 4.5



This ratio, which reflects the population of physics students by gender at the three schools, suggests that there is still a gender balance among students pursuing physics to higher levels at O and A level Physics in Chegutu district. This is well balanced as physics has been perceived for a long time as a male domain.

4.2.1 Data Collection

The research interviews with science heads of department and students focus groups served as the primary source of research data. After every four interviews, the batch of four interviews was recorded manually and reviewed for emerging themes. These focus group interviews were

conducted for O level and A level students. The questionnaires for science teachers, O level and A level students at Sandringham, St Ericks and Vimbai high schools served as supporting research data. Following this method, the researcher ensured grounded theory methodology was embedded throughout the data collection part of the research process.

4.2.2 Data and Analysis.

All interviews were conducted on a voluntary basis. The interviews were analyzed in batches of four participants, allowing analysis time before moving on to additional participants. The feedback from the interviews and questionnaires highlighted points that the researcher bunched into themes that can be implemented such that there is improvement in the Physics pass rates both at O level and A level in Chegutu district.

4.2.2.1 Mathematical ability and the pass rate.

The responses from questionnaires and participation in the data gathering process was on a voluntary basis. The participants expressed their views on how the performance in Physics can be enhanced. The correlation of Mathematical ability and the passing of Physics was explored. The research findings were made in the district of Chegutu. O level and A level students took part as respondents in the qualitative paradigm.

Students from various schools in Chegutu district were issued questionnaires that investigated their views on the correlation of math and physics. The schools included St Ericks High School, Vimbai High School and Sandringham High school. Both O level and A level students took part in this process. At O level, boys from the three schools totaled up to 22 and girls totaled up to 21. There was a balance

in both genders as compared to A level, which had a total of 15 boys and 11 girls. This clearly exhibited that there is a high number of girls who are not excelling at O level in order to take up the science subjects at A level. This clearly shows that gender differences provide evidence that gender issues impact achievement in mathematics. Hence, it is crucial for educators and researchers to pay attention to gender differences in the design of mathematics instruction. The responses from the participants were subjective.

Randomization sampling was employed in this study for sample data collection since the data lent itself to an equal chance of being selected. Three (3) schools were selected for the population for Chegutu district schools.

Data Analysis of Gender distribution among students.

Fig 4.5 shows the gender distribution of the sampled students.

Fig 4.5

Gender	**Number of respondents**	**Percentage**
Male	37	53.6%

Female	32	46.4%
Total	69	100%

Analysis of Age Group

Fig 4.7 shows the age distribution of the sampled students.

Fig 4.7

Age	**Number of respondents**	**Percentage**
Below 12	0	0
13-16	43	62.3%
16-18	26	37.7%
Total	69	100%

From the given interviews and questionnaires, the following recommendations were given. Every area has got its challenges and this is a summary of all the responses that were gathered from the respondents.

4.3 Summary

Students' performance in mathematics determines their performance in physics.

Effective application of mathematics in physics enhances students' performances in physics. As such, mathematical knowledge, skill, memorization of formula and effective application is essential for the excellent performance of O level and A level students in Chegutu District. Mathematics teachers should ensure adequate and indepth teaching of mathematical concepts to science students. Students should be encouraged to learn how to solve problems on their own and to know the required skills.

Teachers of physics should be individuals who have firm grip of mathematical skills and concepts to avoid having issues of students who are only good theoretically but cannot solve mathematical problems which are basic and pivotal in the performance of students in physics.

Students should also learn to visualize the mathematical relation behind every physics theory and concept. Students should practice physics calculations regularly, starting easy and generally getting harder. It will actually take time to become good at calculations. As such, students should persevere. Once the student can do the basics quickly and easily, the student should pick challenges, stretch his/her abilities and aim to do calculations as quickly and accurately in physics.

CHAPTER 5: SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter gives a sum of the dissertation, conclusions and recommendations on how Physics pass rate can be improved in the Chegutu district. The relationship between mathematics and physics is one of great intimacy, with mathematics serving as an essential tool for understanding and describing the laws of the physical world.

Physicists utilize mathematics as a powerful tool to answer questions and describe physical phenomena. It provides the structure for analysis, calculations and reaching scientific conclusions. In addition, Mathematics and Physics are closely intertwined and connected fields. Mathematics is not just a tool for physicists, it is a fundamental part of the language of Physics. The two disciplines are deeply interconnected, with Mathematics providing the framework for expressing and understanding the fundamental laws of physics.

5.2 Summary of the findings

In both O level and A level, physics, mathematics plays a crucial role and it is a prerequisite for success. The findings among the participants in the questionnaire and interviews eluded that, in O level physics, a solid understanding of mathematical concepts is essential for comprehending and solving various physics problems. Mathematics is used to describe physical phenomena, analyse data and derive formulas and equations that are fundamental to the study of physics. Similarly, at A level Physics, a strong foundation in mathematics is vital for grasping advanced physics concepts.

Mathematics is integral to topics such as mechanics, electricity and quantum physics. It is often used to derive and understand the mathematical relationships that govern physical phenomena. Additionally, the proficiency in mathematics is often a requirement for pursuing further studies or careers in physics-related fields. For instance, many universities and colleges require a certain level of mathematical proficiency for admission to physics or engineering programs.

In summary, mathematics is indeed important in passing physics at both O Level and A level, as it forms the backbone of fundamental concepts and problem-solving techniques in physics. The application of mathematics to physics emphasizes the idea that the equations representing the laws of motion should be of a simple form. This highlights the importance of mathematical elegance and simplicity in describing physical phenomena. The mysterious link between mathematics and physics is further exemplified by the existence of quantum entanglement, a physical

phenomenon that allows mathematicians to solve problems that seem to be insurmountable through classical means.

5.3 Conclusions.

In summation, schools in Chegutu district should embrace mathematics and physics since the two are deeply intertwined, with mathematics serving as a fundamental language and a tool for physicists to describe, analyse and understand the physical world. Several factors were noted to influence a student's success in passing mathematics as well as physics.

Firstly, students' attitudes towards learning can impact their performance. Strategies aimed at improving attitudes and engagement can lead to better pass rates in both mathematics and physics.

In addition, desirable academic attributes and successful completion of competency assessments can influence students' ability to pass mathematics. The effectiveness of curriculum and teaching methods can have a substantial effect on the process in mathematics.

Furthermore, mathematics anxiety, which can be influenced by age, is another factor that can affect students' performance in Mathematics. Academic support, as well as specific independent variables, can play a role in students' success in passing mathematics examinations.

A strong grasp of fundamental physics concepts such as forces, motion, energy and electricity, is crucial for success at both O level and A level. The ability to understand and conduct practical experiments, as well as interpret and analyze experimental data, is important for success in physics at both O and A level.

Mathematics plays a significant role in physics particularly at A level, where a strong foundation in mathematics is essential for understanding advanced physics concepts and solving mathematical problems related to physics. Developing critical thinking

and analytical skills is important for understanding and interpreting complex physical phenomena and theories.

The quality of instruction, access to resources and practical laboratory facilities can significantly impact students understanding and performance in physics. Students' motivation, interest and engagement with the subject can influence their success in passing physics at both O level and A level in the district of Chegutu.

5.4 Recommendations

In sum, I believe that intervention from this research can stand toe-to-toe with the interventions from other studies. After all, it helped developed the students' cognitive (e.g., understanding of physics concepts and affective (e.g., interest in learning physics) domains pertaining to secondary physics education, and aided the teacher in being more effective during revision lessons. Also, it is the only intervention targeted at a secondary level that is concept and topic (Benson Soong Page 225) agnostic.

In my opinion, the intervention is effective because it is explicitly based on a sociocultural perspective that aimed at bringing about a change in classroom pedagogical practices. With a change in practices comes a change in how students and their teacher interacted, thereby changing how everyone felt and acted towards physics revision. This change in pedagogical practices was enabled because, as a collective school-based community, the Chegutu district agreed that there is need to focus on helping students understand physics concepts better, and the students' problem-solving skills.

I recognised how secondary schools typically divide their labour might make it difficult for the intervention to be immediately implementable, but because the intervention does not require specialised technology or educators to implement. I remain hopeful that teachers would be able to conduct the intervention when the need arises, or even as part of their standard revision practice. Given the "crisis" in physics education and the identified need to improve the teaching and learning of physics in

secondary science classrooms, it is important that research efforts are put into finding ways of improving secondary physics classroom practices.

Also, with the increased use of ICT in classrooms but the “no significant difference” findings various research studies have found, it is important for research to contribute to the design of ICT-infused learning environments that would result in significant improvements in learning outcomes. From a practical perspective, the research study contributes to schools in Chegutu district, by sharing the design and practice of an intervention that led to significant improvements in students' learning outcomes, both from cognitive and affective fronts.

Also, given the intervention's sociocultural groundings, it contributes to the growing research interest in designing dialogic learning environments. From a theoretical perspective, the study illustrates the importance and relevance of sociocultural theory in the design of learning environments that engages the cognitive and affective domains of students, thereby changing them. It shows that an environment that intentionally and explicitly encourages meaningful “talk” between teacher and students, as well as between students themselves, can positively transform and enhance both teaching and learning experiences without the need of fanciful technology (as commonly advocated by educational technology vendors).

The study also contributes to an increased understanding of students' difficulties when they solve physics problems. It shows that non-physics related deficiencies may impede students' physics problem-solving attempts regardless of the questions.

Also, given the intervention's sociocultural groundings, it contributes to the growing research interest in designing dialogic learning environments. From a theoretical perspective, the study illustrates the importance and relevance of sociocultural theory in the design of learning environments that engages the cognitive and affective domains of students, thereby changing them. It shows that an environment that intentionally and explicitly encourages meaningful “talk” between teacher and students, as well as between students themselves, can positively transform and enhance both teaching and learning experiences without the need of fanciful technology (as commonly advocated by educational technology vendors).

The study also contributes to an increased understanding of students' difficulties when they solve physics problems. It shows that non-physics related deficiencies may impede students' physics problem-solving attempts regardless of the students' understanding of the physics concepts involved, therefore suggesting that nonphysics related interventions may be important to help students solve physics questions better. In my opinion, the study also informs sociocultural theory by elucidating the conditions in which a teacher may scaffold students' construction of knowledge within their individual zones of proximal development.

In my opinion, there are two key reasons why such a classroom practice creates effective individual zones of proximal development. Firstly, on the part of the students, they had worked hard at attempting to solve the questions posed with a peer, and as Howe et al., (2005) have shown, there are incubation and delayed effects associated with peer collaboration. Hence, when those questions are discussed again by the teacher, the students' minds are more 'prepared' and so they gain more from the instruction that follows.

Firstly, students gain an interest in physics, which is important from a societal perspective (Venville, G. J etal, 2019) since they would be much more likely to read physics/engineering at post-secondary level. Secondly, students' grades would improve as a result of better understanding. The ultimate point is simple and obvious verbal communication is but one form of dialogue, and researchers (and practitioners) should consider evaluating other forms of dialogue in order to facilitate students' cognitive development

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APPENDICES

Appendix 1.1: Interview.

The aim of this interview is to establish the main cause of poor performance of science subjects and get views regarding what should done in order to improve the performance in Physics in the Chegutu District.

Note that:

- **This interview is on a voluntary basis.**
- **The answering of the questions is not compulsory.**
- **The responses are subjective**.

<u>Heads of Science Department / Science subjects' teachers.</u>

1. **Write the name of your school and your position at the educational institution. Indicate whether you are an O level or A level teacher.**

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……

2. How many years have you been teaching science subjects?

……

3. May you outline the reasons behind the underperformance of students in science subjects at your school/Chegutu district at large.

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4. What do you think should be done to enhance the performance in Mathematics and Physics at your school/ Chegutu district.

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5. Do you have the appropriate equipment that fully comply with the effective emphasis of the physics curriculum?

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6. How are your students performing when you are teaching calculus, algebra and trigonometry.

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7. **Are the concepts of theoretical physics, quantum mechanics and astrophysics being understood by students?**

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8. **What do you think can be done to improve the understanding of theoretical physics, quantum mechanics and astrophysics in teaching and learning of Physics.**

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9. **How is Mathematics and Physics related?**

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10. **Do you have any suggestions on how the performance in Physics can be enhanced in your district?**

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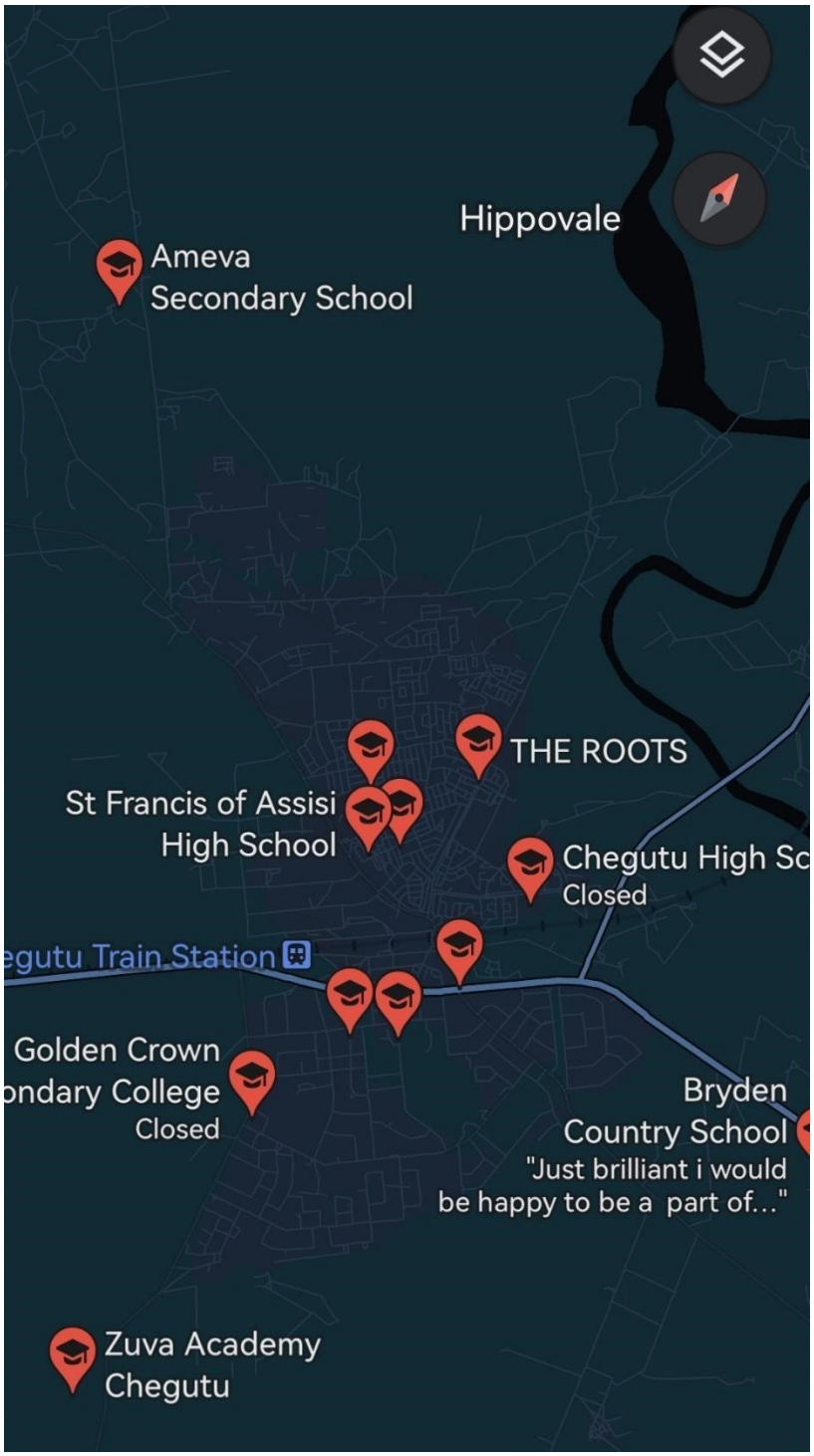
Thank you for taking part in the interview.

Appendix 1.2: Questionnaire.

Questionnaire- Maths and Physics Rel

Appendix 1.3: Map showing Chegutu district.


Hippovale
Ameva
Secondary School
THE ROOTS
St Francis of Assisi
High School
Chegutu High Sc
Closed
egutu Train Station
Golden Crown
ondary College
Closed
Bryden
Country School
"Just brilliant i would
be happy to be a part of..."
Zuva Academy
Chegutu