

**BINDURA UNIVERSITY OF SCIENCE EDUCATION
FACULTY OF SCIENCE EDUCATION**



*An investigation into challenges faced by form 4 learners
in solving circle geometry problems at Gozi secondary in
Mudzi district.*

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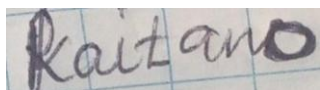
**A RESEARCH PROJECT SUBMITTED TO THE FACULTY OF SCIENCE
EDUCATION, IN PARTIAL FULFILLMENT OF HONORS BACHELOR OF SCIENCE
EDUCATION IN MATHEMATICS (HBScEd -Mathematics) AT BINDURA UNIVERSITY
OF SCIENCE EDUCATION.**

JUNE, 2025

DECLARATION

1. STUDENT

I, KAITANO PETER, Registration Number B231471B, declare that this dissertation titled: “*An investigation into the challenges faced by form 4 learners in solving circle geometry problems at ordinary level*” and affirm that it has not been submitted to any other university in support of other similar qualification. I authorize the Bindura University of Science Education to use this dissertation to their institutions or individuals for purposes of scholarly. I declare that all the sources I have used or quoted have been indicated with complete references.



Signature..... Date.....30/06/2025.....

2. SUPERVISOR

I confirm that this dissertation was carried out by this student and submitted for review with my approval.

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3. CHAIRPERSON OF THE DEPARTMENT

I certify to the best of my knowledge that the required procedures have been followed and the preparation criteria have been met.

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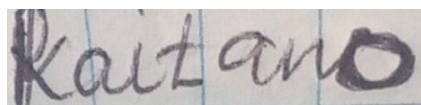
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A photograph of a handwritten signature in dark ink on a light-colored background. The signature appears to read 'Kaitano'.

SIGNED BY..... **DATE.....30/06/25.....**

DEDICATION

This project is dedicated to my wife Kufandirori Princess, my child Charlotte Kaitano and my mother who have inspired and supported me throughout my study up to the completion of this project.

ACKNOWLEDGEMENT

I am extremely grateful to my supervisor Dr Chagwiza with all the help and guidance that he offered me and the encouragement to accomplish this project. I am forever indebted to all those who participated in this project by sharing their time and knowledge.

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I also thank my family for the great sacrifices they made in providing me with the support that I needed and above all I thank God the Almighty for guiding me.

ABSTRACT

This study investigated the challenges faced by form 4 learners in solving circle geometry problems at Gozi secondary school in Mudzi. A mixed methods approach was employed, combining both quantitative and qualitative data collection and analysis methods. A sample of 20 learners was selected using stratified random sampling. Data was collected through a geometry test, survey questionnaires, and pre-focused observations. The study revealed that learners face significant challenges in solving circle geometry problems, including understanding circle theorems, applying formulas, and visualizing problems. The results also showed that limited resources and inadequate teacher support contribute to learner's difficulties in solving circle geometry problems. The study recommends that teachers should provide targeted support and resources, educators receive training and development opportunities, and the curriculum be reviewed and developed to ensure a comprehensive approach to teaching circle geometry. The findings of this study have implications for mathematics education in Zimbabwe and can inform strategies to improve learner performance in circle geometry.

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Chapter 1: THE PROBLEM AND ITS SETTING

1.1 INTRODUCTION OF THE STUDY.

Circle geometry is one of the very important concepts in mathematics education particularly at ordinary level however, many form 4 learners struggle to understand the underlying principles and apply them to solve problems. This investigation aims to explore the challenges faced by form 4 learners in solving circle geometry problems, with a focus on identifying the underlying causes of these difficulties and potential strategies for improvement.

1.2 BACKGROUND TO THE STUDY

Developing logical thinking and problem solving abilities depends critically on mathematics instruction. A basic subject that students run across at ordinary level is geometry more specifically circle geometry. Studies show that a lot of students have trouble with geometry, particularly circle geometry, because of a lot of things like, poor instruction techniques such as conventional methods of instruction typically fail to encourage significant knowledge and involve pupils, not enough practice in the sense that learners have too few chances to apply and practice ideas from circle geometry as well as insufficient knowledge of fundamental ideas in the sense that learners lack of ability to comprehend fundamental geometric ideas and theorems.

Research on learning circle geometry reveal major challenges for students. According to a Sri Lankan research, students had difficulty applying more than one theorem to solve issues and sketching diagrams for certain mathematical situations. The research suggested using active-based learning approaches to get past these challenges (Silmi et al., 2022).

Zimbabwe's focus on generating students who can compete globally further complicates the problems faced by learners in circle geometry in the framework of Zimbabwe. Gozi secondary school in Mudzi, is a typical rural school with comparable difficulties in mathematics teaching.

Circle geometry presents difficulties for pupils at the school, which causes poor grades in mathematics. In order to meet these difficulties, teachers should look into the particular problems learners in circle geometry encounter and then look for possible answers. Investigating the root reasons of these difficulties helps facilitators to create focused interventions aimed at enhancing teaching methods and mathematics achievement of students.

1.3 STATEMENT OF THE PROBLEM

Poor achievement and low confidence in mathematics have stemmed from the continual difficulties students at Gozi secondary school in Mudzi, encounter with circle geometry at Ordinary level, even if mathematics education is important, students often have trouble understanding and using ideas like theorems and formulas from circle geometry. Because the exact character of these difficulties and their underlying causes are unclear, facilitators find it challenging to design focused activities worse still are the possible results of failing in mathematics, which include few job and educational options. Students who find circle geometry challenging could grow to hate mathematics for the rest of their lives, which could significantly affect their future chances.

This study aims to look into the problems students encounter when working with circle geometry at Ordinary level , try to find out what are the causes of these problems and how facilitators can address those problems with a particular emphasis on Gozi secondary school in Mudzi.

1.4 RESEARCH QUESTIONS

What challenges do learners face when solving circle geometry problems?

What are the causes these difficulties?

What can be done by the educators to reduce those challenges?

1.5 ASSUMPTION OF THE STUDY

Gozi secondary school in Mudzi students encounter same difficulties in circle geometry as those faced by pupils in other comparable settings.

Gozi secondary school facilitators are qualified and trained to teach mathematics.

Responses from the students to survey questionnaires will be open and indicative of their knowledge of circle geometry.

The results of the research will be applicable to other related situations and give insightful analysis of the difficulties learners in circle geometry encounter.

1.6 SIGNIFICANCE OF THE STUDY

Several players will find value in this research on the difficulties students have managing circle geometry at Ordinary level, including a case study of Gozi secondary school in Mudzi.

The findings of this study will guide instruction methods and offer new perspectives on how to best teach circle geometry, therefore improving learner knowledge and performance.

The study will help to create focused treatments by pointing out particular issues and root causes, therefore enhancing students, experiences and results in arithmetic.

The recommendations from the study will help shape curricula and guide policy decisions to guarantee that mathematics instruction is geared to fit the needs of pupils.

The study will offer insightful analysis of the obstacles students encounter in circle geometry and guide next research projects, therefore adding to the current knowledge base on mathematics education.

The study has ramifications for mathematics education more generally and supports the continuous initiatives to raise mathematics learning results beyond Gozi secondary school setting.

1.7 LIMITATIONS OF THE STUDY

1.7.1 Sample size and scope

The study looks at a particular case study of Gozi secondary school in Mudzi, which might make it hard to apply the results to other situations.

1.7.2 Methodological Limitations

The study's use of self reported information from students may lead to errors and limits on the depth and accuracy of its results.

1.7.3 Contextual Factors

The results of the research depend on things that are specific to Gozi secondary school, like how many resources are there, how much experience the teachers have, and what kind of students they are.

The study's emphasis on circle geometry might not reflect the whole spectrum of obstacles students encounter more generally in mathematics.

These limits underline the need to exercise care in extrapolating the results of the research to other settings and in drawing conclusions from them. Future studies may extend this work by looking at more broadly the issues students encounter in mathematics and by resolving these constraints.

1.8 DELIMITATIONS OF THE STUDY.

1.8.1 Geographical Scope

The research is limited to Gozi secondary school in Mudzi and could not be representative of other schools or areas.

Excluding other branches of mathematics, the study particularly concentrates on difficulties students at Ordinary level encounter in circle geometry.

The study will include teachers and students from Gozi secondary school, especially those who are teaching and learning circle geometry.

1.8.2 Methodological Approach

The research will use a particular research plan and strategy that might not cover all facets of the issue under investigation.

These restrictions set the limits and scope of the study, therefore enabling a concentrated study of the difficulties encountered by students handling circle geometry at Ordinary Level.

1.9 DEFINITION OF TERMS

Circle Geometry

Circle geometry is a fundamental area within geometry that examines the properties and relationships of circles, including angles, chords, tangents, arcs, and sectors. It provides a basis for developing spatial reasoning and logical thinking in mathematics education. Mastery of circle geometry enhances students' understanding of symmetry, measurement, and problem-solving strategies in both theoretical and real-world contexts (Van den Heuvel-Panhuizen & Drijvers, 2020).

Challenge.

A challenge refers to a situation or condition that presents difficulty, resistance, or complexity requiring problem solving, adaptation, or innovation to overcome. In educational and social contexts, challenges may hinder progress or development but can also foster resilience, creativity, and learning when addressed constructively (Zimmerman, 2021).

A challenge refers to a complex situation that requires effort, skill, or strategy to overcome.

A form 4 learner

A form 4 learner refers to a student in their fourth year of secondary education, typically around 14 to 15 years old (Zvavahera, 2020). At this stage, learners are preparing for their Ordinary Level (O-Level) examinations and are building on their foundational knowledge and skills to pursue further education or vocational training (Ministry of Primary and Secondary Education, 2015).

A learner is an individual actively engaged in acquiring knowledge, skills, attitudes, or values through study, experience, or instruction. Contemporary learning theories emphasize the learner's role as an active participant who constructs meaning and applies knowledge in context (Schunk, 2021).

In this study a learner is a student who is studying mathematics at Ordinary Level, specifically those enrolled at Gozi secondary school in Mudzi.

1.10 CHAPTER SUMMARY

This chapter is focused on the background of the study, research problem, purposes of study, research objectives and significance of the study and on the following we will focus on the literature related to the research problem.

Chapter 2: LITERATURE REVIEW

2.1 Introduction

Circle geometry is a basic mathematical idea that explores the characteristics and relationships of circles. Even though it is important, students sometimes find it hard to solve problems about circle geometry, which can make it difficult for them to understand and do well in math. Various studies have examined the difficulties students encounter when answering circle geometry questions, therefore revealing the root causes and possible fixes. The purpose of this review of the literature is to combine the results of these studies, looking at common problems, teaching methods, and strategies that might help students get over problems in circle geometry.

The literature review will look at what was written about teaching circle geometry, paying close attention to the mental, teaching, and environmental elements that affect how well students understand and solve problems. Reviewing the findings of earlier research, this review seeks to shed light on the difficulties faced by students and guide good teaching methods that could improve their grasp and performance in circle geometry.

2.2 THEORETICAL FRAMEWORK

The Van Hiele Theory as a Theoretical Framework for Learning Geometry.

The teaching and learning of geometry have long presented challenges for educators, particularly in helping students move from concrete understanding to abstract reasoning. The Van Hiele theory, developed in the 1950s by Dutch educators Pierre and Dina van Hiele, offers a valuable theoretical framework that explains how students progress in their understanding of geometric concepts.

Rooted in cognitive development, the theory outlines distinct levels of geometric thought and emphasizes the importance of instructional support in transitioning from one level to the next.

At the core of the Van Hiele theory are five hierarchical levels through which learners typically progress.

Visualization-learners recognize shapes based on appearance.

Analysis- properties of shapes become the focus

Informal Deduction-where learners understand the relationships between properties and begin to form logical arguments.

Formal Deduction-involving rigorous proof and logical structure.

Rigor-where learners compare different geometrical systems and use abstract reasoning. Each level builds upon the previous one, and learners cannot effectively operate at a higher level without mastering the earlier stages.

Another critical aspect of the Van Hiele framework is its emphasis on the role of instruction. Unlike Piaget's theory, which attributes developmental stages to age and maturation, the Van Hiele model asserts that progress through the levels is largely dependent on appropriate teaching. The theory outlines five instructional phases: information, guided orientation, explanation, free orientation, and integration. These phases are designed to facilitate deeper understanding by engaging students in structured exploration and reflection.

Contemporary research continues to validate the Van Hiele Theory as an effective guide for teaching geometry. Curriculum designers and educators use it to create developmentally

appropriate learning experiences, ensuring that tasks align with students' cognitive levels. In Zimbabwe, as in other education systems, the theory supports learner-centered approaches and informs practices such as the use of manipulatives, visual aids, and real-life applications in mathematics instruction.

The Van Hiele theory can be linked to the research on challenges faced by Form 4 learners in solving circle geometry problems in several ways

Levels of geometric thinking

The Van Hiele theory proposes that learners progress through levels of geometric thinking, from visualization to formal deduction. The research can explore which level(s) the Form 4 learners are at and how it affects their ability to solve circle geometry problems.

Understanding of geometric concepts

The theory emphasizes the importance of understanding geometric concepts and relationships. The research can investigate whether learners have a solid understanding of circle geometry concepts and how this affects their problem-solving abilities.

Development of geometric reasoning

The Van Hiele theory highlights the importance of developing geometric reasoning skills. The research can examine whether learners are able to apply geometric reasoning skills to solve circle geometry problems.

Teaching and learning

The theory suggests that instruction should be tailored to the learner's level of geometric thinking. The research can explore whether the teaching methods used in Form 4 classes are effective in promoting learners' understanding and problem-solving skills in circle geometry.

By linking the research to the Van Hiele theory, the researcher gain a deeper understanding of the challenges faced by form 4 learners in solving circle geometry problems and identify potential solutions to address these challenges.

2.3 RELATED LITERATURE

Fitzgerald Abakah (2022) in his journal entitled “high school learners challenges in solving circle geometry problems” is paper reports on a study that investigated high school learners’ difficulties when solving circle geometry problems. This study was conducted on the premise that, if these difficulties are well-known, then the teacher will be guided, to implement appropriate instructional strategies to address them. High school mathematics learner’s poor performances in examinations(formal/informal), nationally, necessitated this study. A high school in the Northern Cape province was purposefully sampled to serve as the research field for the study and circle geometry lessons were conducted, with the study participants. Thereafter, activities, investigation tasks, class work, home-work and standardized tests were administered to collect data. Data was also collected through classroom observations, video recordings and field notes. This was qualitative research hence, qualitative procedures were followed for data collection, analysis and interpretations. Content analysis was carried out on participants’ written responses to the standardized tests, utilizing, Newman’s Error Analysis model to inductively, identify participants challenges, which also served as the theoretical framework for the study. The analysed data revealed that learners do not understand circle geometry concepts, hence, their inability to make connections across geometry concepts to solve geometric problems. The researchers concluded

this lack of fundamental background prevents learners from applying appropriate techniques in solving circle geometry problems. The researchers highly recommended that learning and teaching materials, particularly, technological learning and teaching aids must be inculcated in the learning and teaching of geometry in South African high schools. The researchers posited that this would help in eradicating students' errors, difficulties, and misconceptions. The unavailability of these materials forces geometry instructions to be carried out in an abstract manner which impedes learners' understanding and problem-solving skills.

Suglo Kabinaa Enoch (2024) in his research entitled "Using applicable theorems for solving circle geometry problems: A correlational study of senior high school student's academic performance in circle geometry". The primary objective of this research was to examine the theorems students employ when solving circle geometry problems and how this impacts their academic performance in the subject. The study was designed around the null hypothesis that students' use of applicable theorems for tackling circle geometry questions do not significantly affects their academic achievement in this area. It was a quantitative study involving a total population of 460 students, with a sample size of 210 selected through probability systematic sampling. Data collection utilized a questionnaire and an achievement test instrument, while analysis methods included descriptive statistics and simple linear regression analysis. The study found that the use of relevant theorems in solving circle geometry problems has a statistically significant impact on students' academic performance in this field $=.012$, $t(210) = 8.585$, $p(< .001)$. Given this significant finding, it is recommended that educators and curriculum developers highlight the importance of theorem application in teaching circle geometry to enhance students understanding and performance in the subject. The study made the following recommendations based on the research finding that

students' use of applicable theorems for solving circle geometry related questions has a statistically significant influence on their academic performance in circle geometry, it is recommended that educators and curriculum designers emphasize the importance of theorem application in teaching circle geometry.

Romuald Koffi Mifetu (2023) in the research journal entitled “ using activity method to address students problem solving difficulties in circle geometry” action research sought to address the problem-solving difficulties of students in circle geometry problems using activity method of teaching and in solving circle geometry problems. It also found out how activity method of teaching and learning helped address the students' difficulties of solving circle geometry problems. Finally, it established the extent to which the activity method of teaching and learning affected the performance of students in circle geometry. The accessible population was all form two students at Zion College in the Volta Region of Ghana. It numbered 499. The sample was general science 2B students. The sample size was 27 students made up of 10 girls and 17 boys. The instruments for data collection were pre- and post-test. The pre-test was conducted to establish the existence of the difficulties of students in solving circle geometry problems. After establishing the problems, activity method of teaching and learning was used as an intervention to remedy the situation. A post-test was administered to measure the improvement. The data was presented using tables and figures. Inferential statistics was also used to analyze the data. From the analysis, activity method help the students solve complex questions, which demand multiple circle theorems to solve. It was recommended that mathematics teachers should always use activity method of teaching and learning in teaching circle geometry. Findings have shown that activity method of teaching and learning helped tremendously in improving student's achievements in circle geometry. Due to that, universities and colleges of education was encouraged to equip their mathematics teacher trainees

with adequate skills in using activity method in teaching and learning as well as training should be organized by the Ghana Education Service and Schools to refresh mathematics teachers on various ways of teaching circle geometry using activity method.

Jeremiah Madzimore(2023) in his journal entitled the challenges faced by high school in circle geometry posits that the teaching and understanding of geometry, especially grade 11 circular geometry, is a serious challenge in South Africa. The problems that learners encounter when learning circular geometry are increasing. The aim of the study was to identify the factors that contribute to learners' hurdles and misconceptions when studying circular geometry in grade 11, as well as suggestions for improving performance and overcoming the issues they face. A descriptive survey research design was used in this study. 130 participants from five distinct district regions, that is, 25 maths teachers, 100 students, and five principals made up the sample size. An online interview, a suggestion box, and three questionnaires, one for learners, teachers, and school principals, were used to collect data for the study. Learners' views toward circle geometry are that they were attending fewer lessons than expected due to the COVID-19 outbreak, and a lack of prior knowledge are all contributing to the challenges and misconceptions they face. The study also found out that learners confuse theorem proof with reasoning. The findings of the study research are expected to give curriculum developers new insights into using Van Hiele theory-based education, innovative tactics for teaching circular geometry, getting students interested in the topic material, and providing more learning programs like the Secondary School Improving Program (SSIP). The sampled five district regions that used Van Hiele theory-based education and attended the Secondary School Improving Program (SSIP) continued to improve on content curricula, overall performance, misconceptions decreased, and learners developed a love for circle geometry and their attitude toward it changed.

Zeinul Abdeen, M.(2022) in his study “Difficulties in learning geometry component in Mathematics and active based learning methods to overcome the difficulties” emphasizes on exploring different representations such as virtual manipulatives, written math formulas, and verbal explanations, which help students build mathematical concepts and develop critical thinking. Student’s performance in G.C.E (O/L) examination in Sri Lanka for the geometry component is at a very low level. This study identifies the difficulties learners face when learning geometry at grade 11 and provide some suggestions for overcoming these issues using active based learning. The study uses a quantitative survey, a diagnostic test, and a teaching experiment conducted with randomly selected three hundred students from grade 11 students and 35 mathematics teachers from 42 schools in Vadamarachchi education zone Sri Lanka. Questionnaires were used to collect data from the teachers and the students. The diagnostic test was also used to collect data from the students. Forty students were selected for the teaching experiment based on diagnostic test results and divided into two equally talented groups using a rubric. The teaching experiment was done to test the effectiveness of activity-based teaching methods in teaching geometry. Findings from the study revealed that students had greater difficulties in learning geometry such as drawing diagrams for a given geometric problem and applying more than one theorem to solve a given geometry problem. Furthermore, students disinterest in the geometry component and their family background affects their geometry learning. Additionally, results from the teaching experiment indicate that the student-based learning approaches are more effective than conventional methods for teaching geometry.

2.4 CHALLENGES FACED BY LEARNERS IN SOLVING CIRCLE GEOMETRY PROBLEMS

2.4.1 Confusing theorem proof with reasoning.

According to Madzimure(2023) in his research entitled challenges faced by high school learners in circle geometry posists that learners often confuse theorem proof with reasoning which is indeed one of the major challenge faced by learners when solving circle geometry problems whereby learners try to use reasoning instead of applying the appropriate theorems which are used to solve the specific circle geometry problem.

2.4.2 Failing to apply appropriate techniques.

Firtzgerald Abakah (2022) in his study high school learners challenges in solving circle geometry problems entails that learners are failing to apply appropriate techniques in solving circle geometry problems in the sense that learners may misapply theorems by using a theorem without checking its conditions or assumptions, misinterpreting or mislabeling diagrams, l upeading to incorrect conclusions, failing to provide adequate evidence or reasoning to support a proof or argument as well as overlooking special cases or exceptions that may affect the solution.

2.4.3 Application of relevant theorems.

Sugloo Kabina (2024) in his research entitled “Using applicable theorems for solving circle geometry problems: A correlational study of senior high school student’s academic performance in circle geometry” shows that learners often fails to apply relevant theorems to the given circle geometry problems. To apply circle geometry theorems effectively, it is essential to follow a few key steps. These include determining which theorems apply to the problem or statement. This requires a deep understanding of the theorems and their applications, visualizing the problem and label relevant points and segments this helps to identify the relationships between different components of the circle, using the theorems to derive conclusions or prove statements. This

requires a thorough understanding of the theorems and their applications as well as supporting the arguments or proofs with logical reasoning and evidence this helps to ensure that the solutions are valid and accurate.

2.5 WHAT CAUSES THOSE CHALLENGES

2.5.1 Lack of fundamental background

Fitzgerald(2022) in his findings entails that lack of fundamental background prevents learners from applying appropriate techniques in solving circle geometry problems. To understand circle geometry, learners need to have a solid foundation in several key areas such as the basic definitions of circle terminology. This includes terms like center, radius, diameter, chord, arc, and tangent. These definitions are the building blocks of circle geometry, and understanding them is crucial for more complex concepts, learners should be familiar with the properties of circles these includes knowledge of circumference, area, and relationships between radii, diameters, and chords which will help you develop a deeper appreciation of circle geometry and enable learners to solve problems and apply concepts effectively, angle properties are also critical in circle geometry. You should understand central angles, inscribed angles, and their relationships to arcs mastering angle properties is essential for solving problems and proving statements in circle geometry as well as circle geometry is theorems and proofs, learners should familiarize with key theorems like the inscribed angle theorem, central angle theorem, and chord properties. Theorems and proofs provide a framework for solving problems and proving statements in circle geometry.

2.5.2 Ineffective teaching strategies

According to Romuald Koffi Mifetu (2023) in the research journal entitled “ using activity method to address students problem solving difficulties in circle geometry” . Ineffective teaching strategies is also contributor to the challenges learners face when solving circle geometry problems such as lack of diagram drawing, misapplying theorems, insufficient labeling, not checking for special cases, and lack of clear justification. These methods can lead to confusion, incorrect solutions, and poor communication of solutions.

2.5.3 Less time of conduct

According to Madzimure(2023) in his research learners believed that less time of conduct is one of the reasons which leads to challenges they face when solving circle geometry problems. This was due to Covid-19 restrictions which limits face to face interactions between teachers and learners. Limited time can impact learners by leading to insufficient understanding of circle geometry concepts. When learners are rushed through lessons or practice, they may not have the opportunity to fully grasp the concepts, leading to gaps in their understanding. This can make it difficult for them to apply the concepts effectively, leading to challenges and difficulties also limited time can make it challenging for learners to retain information and recall it when needed. Circle geometry requires a strong foundation in various concepts and theorems, and learners need time to absorb and retain this information. Without sufficient time, learners may struggle to recall important information.

2.5.4 Drawing diagrams and applying multiple theorems

Zeinul, A(2022) study highlights the challenges students face in learning geometry, particularly in the G.C.E (O/L) examination in Sri Lanka, where performance has been notably low. The

study focuses on grade 11 students and explores active-based learning methods to overcome the following difficulties in learning geometry challenges such as drawing diagrams for geometric problems and applying multiple theorems to solve problems

2.6 WHAT CAN BE DONE TO REDUCE THOSE CHALLENGES

2.6.1 Emphasizing on theorem application

Suglo(2024) in his research recommends on emphasizing on theorem application to reduce problems faced by learners when solving circle geometry problems. Theorem application enables learners to solve problems and prove statements effectively. By applying theorems correctly, learners can develop problem-solving skills, build logical reasoning, and solve complex problems. Theorem application requires critical thinking and logical reasoning, which enhances learners' ability to think critically and approach problems in a systematic way.

To apply theorems effectively, learners should understand theorem conditions, identify relevant theorems, and apply theorems correctly. Understanding theorem conditions is crucial, as it enables learners to recognize the assumptions underlying on each theorem. Identifying relevant theorems requires learners to analyze the problem or statement and determine which theorems apply. Applying theorems correctly involves using the theorems to derive conclusions or prove statements.

2.6.2 Provision of technological teaching and learning aids

Fitzgerald in his research emphasizes on provision of technological teaching and learning aids so as to reduce errors , misconceptions and challenges in solving circle geometry problems.

unavailability of these materials forces geometry instructions to be carried out in an abstract manner which impedes learners understanding and problem-solving skills.

2.6.3 Use of activity method

According to Mifetu(2023), activity method help the students solve complex questions, which demand multiple circle theorems to solve. It was recommended that mathematics teachers should always use activity method of teaching and learning in teaching circle geometry. Hands-on activities are a crucial component of the activity method. By using manipulatives such as circles, protractors, and compasses, learners can explore circle geometry concepts in a tangible and interactive way. This approach helps learners to visualize and understand complex concepts, making them more accessible and memorable. Hands-on activities also enable learners to experiment and investigate circle geometry concepts, developing their critical thinking and problem-solving skills.

The activity method offers several benefits for learners. Hands-on activities improve understanding by helping learners visualize and understand complex concepts. Collaborative learning increases engagement by making learning more enjoyable and interactive. Developed problem-solving skills enable learners to approach problems in a systematic and logical way. By incorporating the activity method, educators can help learners overcome challenges and develop a deeper understanding of circle geometry.

2.6.4 Active based learning and student based learning

Zanul, A(2022) encourages active-based learning approaches, such as virtual manipulatives, written math formulas, and verbal explanations and student-based learning methods, which outperform conventional teaching methods so as to curb those challenges mentioned. Geometry learning can be improved through interactive and engaging teaching methods, student-centered approaches can enhance critical thinking and problem-solving skills as well addressing students' disinterest and family background factors can also contribute to better learning outcomes¹

2.7 CHAPTER SUMMARY

The literature review highlights several references that highlights the challenges faced by form 4 learners when solving circle geometry problems. The studies also points out the causes of those challenges as well as interventions such as emphasizing relevant theorem application, technology assisted teaching and learning have shown its importance in addressing these challenges

Instructors can make use of the insights gained from these studies to drop effective instructional strategy and interventions to enhance students proficiency in solving circle geometry problems.

Chapter 3: METHODOLOGIES

3.1 INTRODUCTION

This chapter outlines the research methodologies used in this study to investigate the challenges faced by learners when solving problems of circle geometry at ordinary level, with a specific focus on form 4 learners at Gozi secondary school in Mudzi district. The research design, sampling strategy, data collection methods, and data analysis procedures are discussed in detail. The study adopts a mixed-methods approach, combining both quantitative and qualitative data collection and analysis methods. This approach allows for a comprehensive understanding of the challenges learners face and provides insights into the underlying factors contributing to these challenges.

3.2 RESEARCH DESIGN

3.2.1 Mixed-Methods Approach

In this study a mixed methods research design was used combining both quantitative and qualitative data collection and analysis methods. The researcher used this approach provides a comprehensive understanding of the challenges faced by form 4 learners in solving circle geometry problems at Gozi secondary school.

3.2.2 Quantitative Component

Creswell, J. D.(2021) entails that quantitative data refers to numerical information that can be measured and analyzed statistically. It includes data such as scores, counts, or measurements collected through structured tools like questionnaires or tests.

Quantitative research involves the systematic collection and analysis of numerical data to understand a phenomenon or test a hypothesis.

3.2.3 Geometry Test

Standardized test was administered to 20 form 4 learners to assess their understanding of circle geometry concepts.

3.2.4 Survey Questionnaire:

A self-administered questionnaire was used to collect data on learners' attitudes and challenges when solving circle geometry problems.

3.2.5 Qualitative Component

Qualitative research involves the collection and analysis of non-numerical data, such as text, images, or observations, to gain a deeper understanding of a phenomenon or experience .According to Poth, C.N.(2021) qualitative data refers to non-numerical information that describes qualities or characteristics. It is typically collected through interviews, observations, or open-ended surveys and is used to explore meanings, experiences, or concepts in depth.

3.2.6 Open-Ended Questions

The survey questionnaire included open-ended questions to gather qualitative data on learner's experiences and challenges.

3.2.7 Data Integration

The quantitative and qualitative data was integrated during the analysis phase to provide a comprehensive understanding of the research problem.

3.2.8 Justification of use of mixed methods design in this study

The use of multiple data collection methods was employed as it provides triangulation, increasing the validity and reliability of the research findings

The mixed methods design provides a comprehensive understanding of the challenges faced by form 4 learners in solving circle geometry problems at Gozi secondary.

3.3 DATA COLLECTION INSTRUMENTS

3.3.1 Geometry test.

A test is a systematic procedure designed to measure an individual's knowledge, skills, abilities, or other characteristics. In educational settings, tests serve both summative and formative purposes, assessing student learning outcomes and guiding instructional decisions. In psychology, tests are standardized tools used to evaluate cognitive, emotional, and behavioral traits, aiding in diagnosis and treatment planning (American Educational Research Association, American Psychological Association, & National Council on Measurement in Education, 2020).

Standardized tests was administered to assess learners understanding of circle geometry concepts.

3.3.2 Justification of the use a geometry test in this study

Geometry test was used for measurement of knowledge quantitative data which will help in identifying the challenges faced by learners in solving circle geometry problems at Gozi secondary school.

3.3.3 Survey Questionnaires

According to Aithal(2020) a survey questionnaire is a structured research instrument comprising a series of questions designed to collect data from respondents about their opinions, behaviors, or characteristics. It is widely used in quantitative research for its efficiency and scalability.

Self-administered questionnaires was used to collect data on learner's attitudes, experiences, and challenges when solving circle geometry problems.

3.3.4 Justification of the use survey questionnaires

The researcher uses a survey questionnaire in this study because it provides insights into learner's perspectives on challenges faced by learners when circle geometry problems , causes of those challenges and some possible interventions to those challenges

3.3.5 Pre -Focused Observations

Lynch (2025) defines pre-focused observation as a systematic approach where the observer concentrates on specific behaviors or events within a study setting, guided by predefined objectives. This method enhances the reliability and validity of observational data.

Observations of teaching and learning processes in the classroom to gather data on instructional practices and learner engagement was used.

3.3.6 Justification why the researcher uses pre-focused observations

The researcher used pre-focused observation in this study to gather information on learners behaviours, interactions and challenges they face when solving circle geometry.

3.4 POPULATION OF THE STUDY

According to Babbie, E.R(2020) a population refers to the entire group of individuals, events, or objects that share a common characteristic and from which a researcher intends to draw conclusions.

A population refers to the entire group of individuals that share common characteristics and are of interest to the researcher . In research, the population is the larger group to which the findings are intended to be generalized .The population for this study consists of all form 4 learners at Gozi Secondary School in Mudzi, Zimbabwe, who are currently studying mathematics and have been exposed to circle geometry concepts.

3.5 SAMPLE

Creswell, J(2021) defines a sample as a subset of the population selected for actual study. It is used to make inferences about the population without examining every member.

A sample is a subset of individuals selected from a larger population, used to represent the population and make inferences about it. The sample is the representative of the population to ensure that the findings can be generalized .A sample of 20 form 4 learners was selected from the population using a stratified random sampling technique. This sample size is considered adequate for a mixed-methods study, allowing for both quantitative and qualitative data collection and analysis.the sample consists of 10 boys and 10 girls.

3.6 SAMPLING TECHNIQUES

3.6.1 Stratified Random Sampling.

Etikan, I(2021) defines stratified random sampling as a probability sampling method where the population is divided into subgroups (strata) based on shared characteristics, and random samples are drawn from each stratum to ensure representation.

Stratified random sampling is a sampling technique used in research to select a sample from a population. It involves dividing the population into distinct subgroups or strata, and then randomly selecting a sample from each stratum. The population is divided into subgroups or strata based on relevant characteristics, such as age, gender, or socio-economic status.

3.6.2 Justification of the use of stratified random sampling.

The study employed stratified random sampling to ensure that the sample is representative of the population, reducing sampling bias. This technique allows for more precise estimates of population parameters, particularly when strata are homogeneous.

3.7 VALIDITY AND RELIABILITY OF RESEARCH INSTRUMENTS

When conducting research, it is essential to make sure that the instruments used to collect data are valid and reliable. This was particularly important in the study "An investigation into challenges faced by form 4 learners in solving circle geometry problems at a secondary school in Mudzi," where the accuracy and credibility of the findings depend on the quality of the measurement instruments. Validity and reliability are two fundamental concepts in research methodology that play an important role in ensuring the trustworthiness of the results.

3.7.1 Validity

Taherdoost, H. (2020) defines validity as the degree to which an instrument or research method accurately measures what it is intended to measure. It ensures that the results of a study reflect the real situation or concept being investigated.

Validity refers to the extent to which a measurement instrument measures what it is supposed to measure. In the context of this study, validity was crucial to ensure that the instruments used to assess learners understanding of circle geometry accurately capture the concepts and skills being tested. To achieve validity, the study employed various strategies, such as content validity, face validity, and construct validity.

Content validity involves ensuring that the instruments, such as tests or questionnaires, cover the relevant content and concepts related to circle geometry. This was achieved by aligning the instruments with the curriculum and learning objectives of the form 4 mathematics syllabus. Face validity, on the other hand, involves ensuring that the instruments appear to measure what they are supposed to measure, as judged by experts or peers. This was achieved by piloting the instruments with a small group of learners and experts to ensure that they are relevant and effective. Construct validity involves ensuring that the instruments measure the underlying constructs or concepts, such as geometric reasoning or problem-solving skills. This was achieved by using instruments that have been previously validated and shown to measure the desired constructs.

3.7.2 Reliability

Heale, R(2021) defines reliability is the consistency or stability of a measurement instrument or research method over time. A reliable tool yields the same results under consistent conditions.

Reliability, refers to the consistency of the measurement instrument in producing the same results under the same conditions. To achieve reliability, the study employed strategies such as test-retest reliability, inter-rater reliability, and Cronbach's alpha. Test-retest, which involves administering the same instrument to the same group of participants on two different occasions to check for consistency, helps to ensure that the instrument is reliable over time.

The study increase the confidence in the findings and provide a more accurate understanding of the challenges faced by form 4 learners in solving circle geometry problems through validity and reliability. This, in turn, inform the development of effective interventions and strategies to support learners in overcoming these challenges. The study's findings contributes to improving the teaching and learning of circle geometry and enhancing learner's understanding and performance in mathematics.

3.8 DATA COLLECTION PROCEDURES

The researcher followed the following procedures in data collection

3.8.1 Permission and Ethical Clearance

The researcher obtained permission from the relevant authorities, such as the school administration particularly the head of Gozi secondary.

The researcher ensured that participants provide informed consent and are aware of their rights and confidentiality which will help to build trust between the researcher and the participant.

3.8.2 Sampling and Participant Selection

The researcher selected a sample of 20 form 4 learners using stratified random sampling and ensured that the sample is a representative of the population and that participants meet the inclusion criteria.

3.8.3 Administration of Questionnaires

The researcher administered the survey questionnaire to the selected sample of learners and ensured that the questionnaire is clear, concise, and relevant to the research objectives.

3.8.4 Administration of the test

Administered some standardized geometry test to assess learner's understanding of circle geometry concepts and ensure that the tests are valid, reliable, and aligned with the research objectives.

3.8.5 Data Quality Control

Ensuring that data was collected systematically and consistently and Check for errors, inconsistencies, and missing data, and take corrective action as needed.

3.9 CHAPTER SUMMARY

The study used a mixed-methods research design, combining both quantitative and qualitative data collection and analysis methods. This approach allows for a comprehensive understanding of the challenges learners face and provides an insight into the underlying factors contributing to these challenges. The study uses several data collection instruments, including pre- and post-tests,

survey questionnaires, and lesson observations. The tests assess learner's understanding of circle geometry concepts, while the survey questionnaires collect data on learner's attitudes, experiences, and challenges when solving circle geometry problems. A sample of 20 learners was selected using stratified random sampling, consisting of 10 boys and 10 girls. This sampling technique ensures that the sample is representative of the population and reduces sampling bias. To ensure the validity and reliability of the research instruments, the study employs various strategies, such as content validity, face validity, and construct validity.

Chapter 4: DATA PRESENTATION AND ANALYSIS

4.1 Introduction

This chapter presented the findings of challenges faced by learners when solving circle geometry problems. The findings are based on the interpretation and analysis of the data obtained through pre-focused observation, questionnaires and tests. Survey statistics results in relation to the objectives of the research are laid out in this chapter

4.2 RESULTS FROM CIRCLE GEOMETRY TEST

Table 1

Shows the marks and percentages obtained by 20 learners on test under study.

Learner	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	Mean
Mark	5	7	0	3	2	5	9	11	1	6	8	7	4	5	3	0	0	2	3	1	4,1
%mark	25	35	0	12	10	25	45	55	05	30	40	35	20	25	15	00	00	10	12	05	20,5

Shows the frequency table of the marks obtained on the circle geometry test by 20 learners under study

Marks	0-10	11-20	21-30	31-40	41-50	51-60	61-70	71-80	81-90	91-100
Frequency	7	4	4	3	1	1	0	0	0	0

4.2.1 ANALYSIS OF THE TEST RESULTS

Tables 1 and 2 above shows the test scores for the twenty learners under study the test was out of 20 and the score was converted to percentages, out of the 20 learners only one learner managed to get a pass mark which is a mark above 50% and the rest managed to get a mark less 50 which shows there are some great challenges which are being faced by learners which needs intervention at large.

4.3 RESULTS OF PRE-FOCUSED OBSERVATION

The tables below shows the results obtained from focused observations carried out during the research time the researcher carried out the observation with twenty targeted learners.

Table 3

A table Showing what was observed on pre-focused observation by the teacher

Raising hands more than 4 times	7
Correct responses	2
Wrong responses	5
Ask questions	3

The table above illustrated that among 20 learners in the experiment, 7 of them raised their hands more than four times during the lesson. This points out that out of 20 pupils, 7 pupils were participating very much during the observation stage. The table also shows that two learners usually gives correct responses .This implies that only 25% were giving correct answers and 75% were giving wrong answers and not participating and this also pinpoints that learners struggles with the concept of circle geometry.

4.3.1 ANALYSIS OF THE RESULTS FROM THE PRE-FOCUSED OBSERVATION.

During the observation, the researcher noted that most of the learners are unable to differentiate trigonometry and mensuration of shapes particularly area of circle , sectors and segments from circle geometry since most of the answers given shows that they are using the wrong concept to solve circle geometry problems. A few managed to use the correct concept of solving circle geometry but they also face a challenge of applying the correct geometry theorem to answer the

given questions this is in line with what was eluded earlier on by Fitzgerald Abakah (2022) in his study entitled “high school learners challenges in solving circle geometry problems” is paper reports on a study that investigated high school learners’ difficulties when solving circle geometry problems which entails that learners do not understand circle geometry concepts, hence, their inability to make connections across geometry concepts to solve geometric problems.

4.4 RESULTS FROM SURVEY QUESTIONNAIRES

LEARNERS SURVEY QUESTIONNAIRE

Table 4

Shows the frequency table on the ages of 20 learners under survey

1. AGE OF LEARNERS

AGE	14	15	16	17
FREQUENCY	4	8	6	2

Table 5

Shows the responses by the 20 learner under study on their level of understanding circle geometry concepts

2. Understanding of Circle Geometry

level	Very poor	poor	good	satisfactory	excellent
frequency	3	8	4	4	1

Table 6

Shows the responses by the 20 learners under study on the challenging aspects on circle geometry.

3. Challenging Aspects

challenge	Frequency
Understanding circle theorem	12
Applying formulas	10
Solving problems involving angles and arcs	14
Visualizing circle geometry problems	8
Others	2

Table 7

Shows the level of frustration or anxiety by learners by the circle geometry topic.

4. Frustration or Anxiety

level	always	often	sometimes	rarely	never
frequency	4	6	6	4	4

Table 8

Shows how learners under the study views teacher support

5. Teacher Support

level	Very poor	poor	good	Very good	excellent
frequency	8	2	6	1	3

Table 9

Shows the resources used by learners when learning circle geometry

Resources Used

Resources used	Number
Textbooks	16
Online materials	2
Educational videos	4

Practical	1
Other	2

3. Additional Resources Needed

Yes: 14 (various responses, e.g., more practice exercises, online resources)

No: 6

Open-Ended Questions

The responses to the open-ended questions would be analyzed qualitatively, identifying common themes and patterns in learners' struggles with specific topics or concepts, suggestions for improving teacher or school support, and ideas for enhancing their understanding of circle geometry.

These frequency tables provide a snapshot of the quantitative data collected from the questionnaire, highlighting trends and patterns in learners' experiences, challenges, and perceptions of support and resources in learning circle geometry.

4.4.1 ANALYSIS OF THE RESULTS FROM THE SURVEY QUESTIONNAIRE

The survey questionnaire from the learners has shown that learners face significant challenges when solving circle geometry problems, including understanding circle theorems and applying formulas which is the same as the research findings by Suglo (2024) whereby the learners are encouraged to apply relevant theorems to solve circle geometry problems for example circle theorems such as the inscribed angle theorem and the circle tangent theorem require learners to have a deep understanding of geometric properties and relationships. However many learners are struggling to apply these theorems to solve problems, often due to a lack of conceptual understanding or procedural fluency.

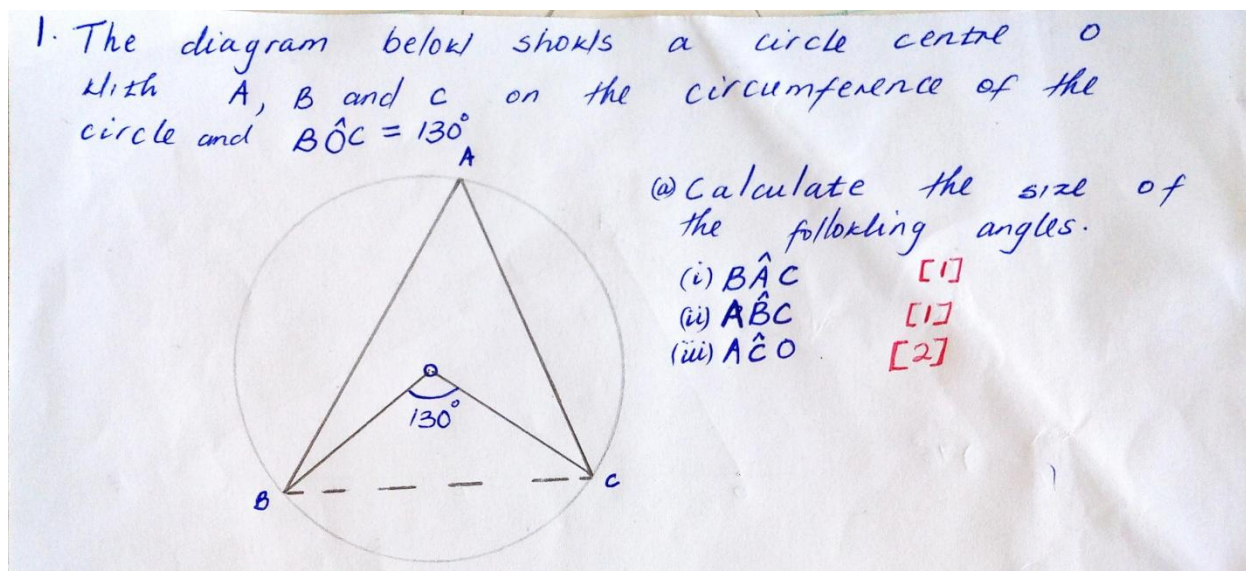
The survey questionnaire also shows that the mainly used resources or teaching and learning are textbooks which is in contradiction with the research findings conducted by Mifetu(2023) where the activity method of learning is encouraged to foster proper understanding of the concepts of circle geometry since practicals also involve activities so there are some common features between survey questionnaire and the research findings by Mifetu.

4.5 CHALLENGES FACED BY LEARNERS WHEN SOLVING CIRCLE GEOMETRY PROBLEMS

4.5.1 Conceptual Understanding

One of the primary challenges learners face is a lack of understanding of circle properties and relationships. Circle geometry requires learners to visualize and comprehend complex relationships between different elements, such as chords, tangents, arcs, and angles. Research has shown that learners often struggle to develop a deep understanding of these concepts, leading to difficulties in solving circle geometry problems from the test results some of the learners shows

that they do not understand the concept of circle geometry they mix up we the concept of measures and mensuration on circles and their parts such as sectors and segments



The given below is one of the questions where some of the learners apply the concept of measures and mensuration instead of geometry concepts and theorems

FIG 4. 4 Shows one of questions were learners apply the wrong concept

Below is one of the answers given by the learner p for the above given problem

Friday 16 May 2025

Test 1: Circle Geometry

1.

(i) $\hat{BAC} = \frac{O}{360} \times 2\pi$
 $= \frac{130^\circ}{360} \times 2 \times 180^\circ$
 $= \frac{130^\circ}{360} \times 360^\circ$
 $= 130^\circ$

(ii) $\hat{ABC} = \frac{130^\circ}{2}$
 $= 65^\circ$

(iii) $\hat{ACB} = \frac{65^\circ}{2}$
 $= 32,5^\circ$

(iv) $\hat{ABC} = 25^\circ + 32,5^\circ$
 $= 57,5^\circ$

(v) $\hat{ACB} = 32,5^\circ$

(vi) $\hat{BAC} = \frac{130^\circ}{2}$ (angle at the centre is twice angle at the circumference)
 $= 65^\circ$

(vii) $\hat{ABC} = 25^\circ + 32,5^\circ$
 $= 57,5^\circ$

(viii) $\hat{ACB} = 32,5^\circ$

$\frac{0}{20}$

4.5.2 Applying Theorems and Formulas

Another challenge learners face is applying theorems and formulas correctly. Circle geometry involves numerous theorems. Learners must not only memorize these theorems but also apply them correctly in different contexts. However, from the observations made by the researcher it has shown that learners are struggling to apply circle geometry theorems and formulas correctly

Fig 4.4 shows the question from the geometry test were most of the learners struggle to apply theorems correctly

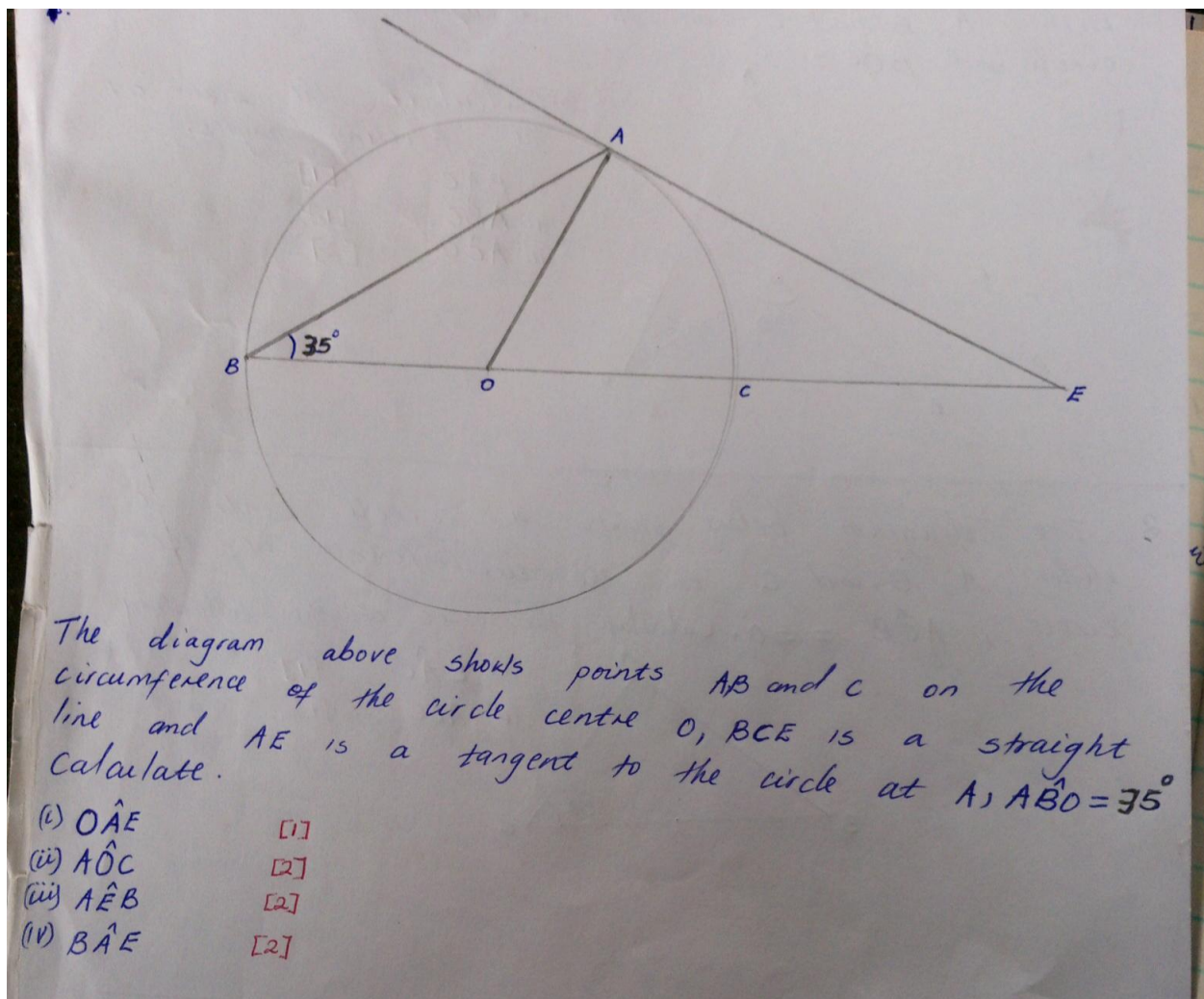
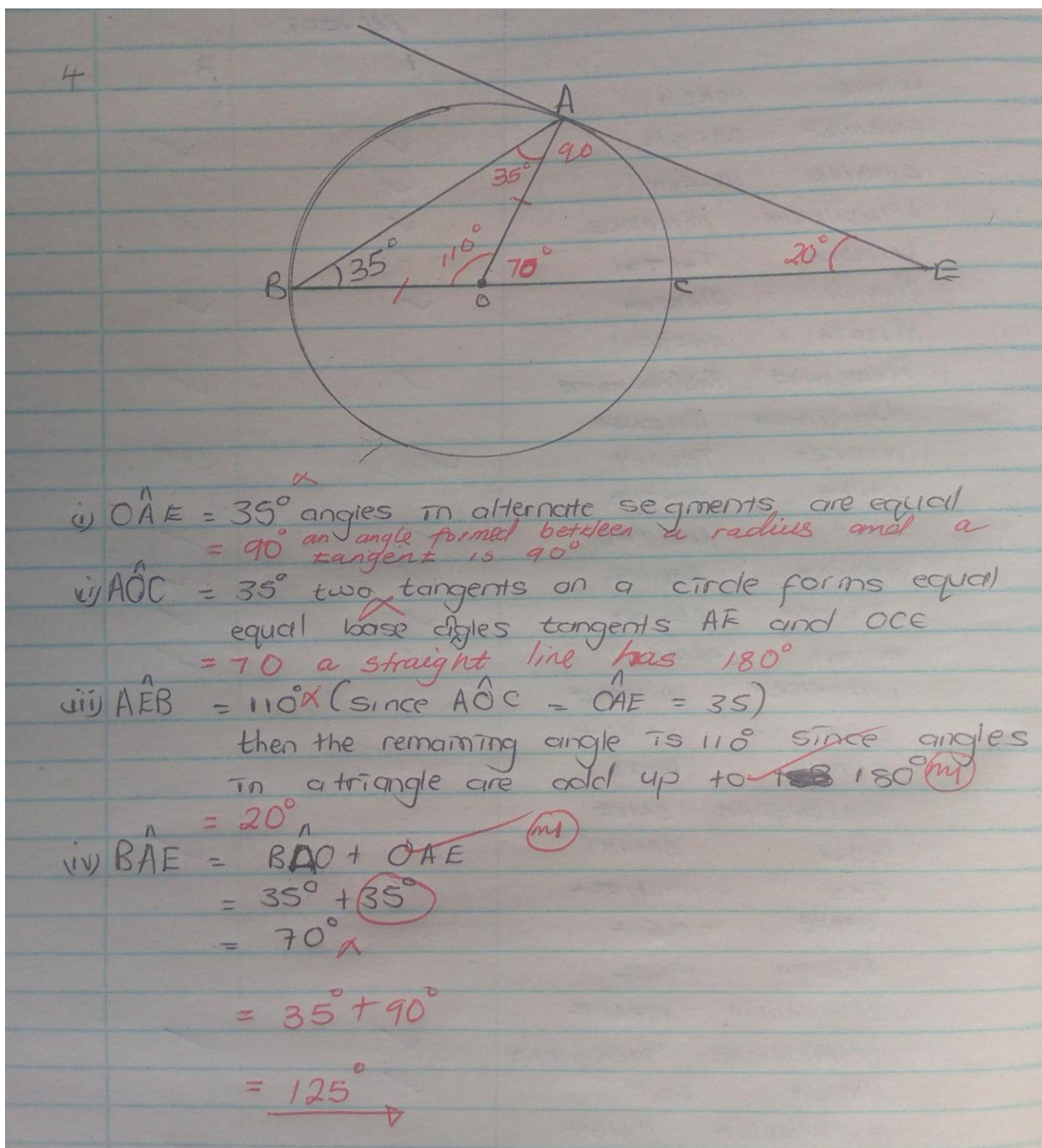


Fig 4.5 shows the answers by one of the learners struggling to apply the correct theorems

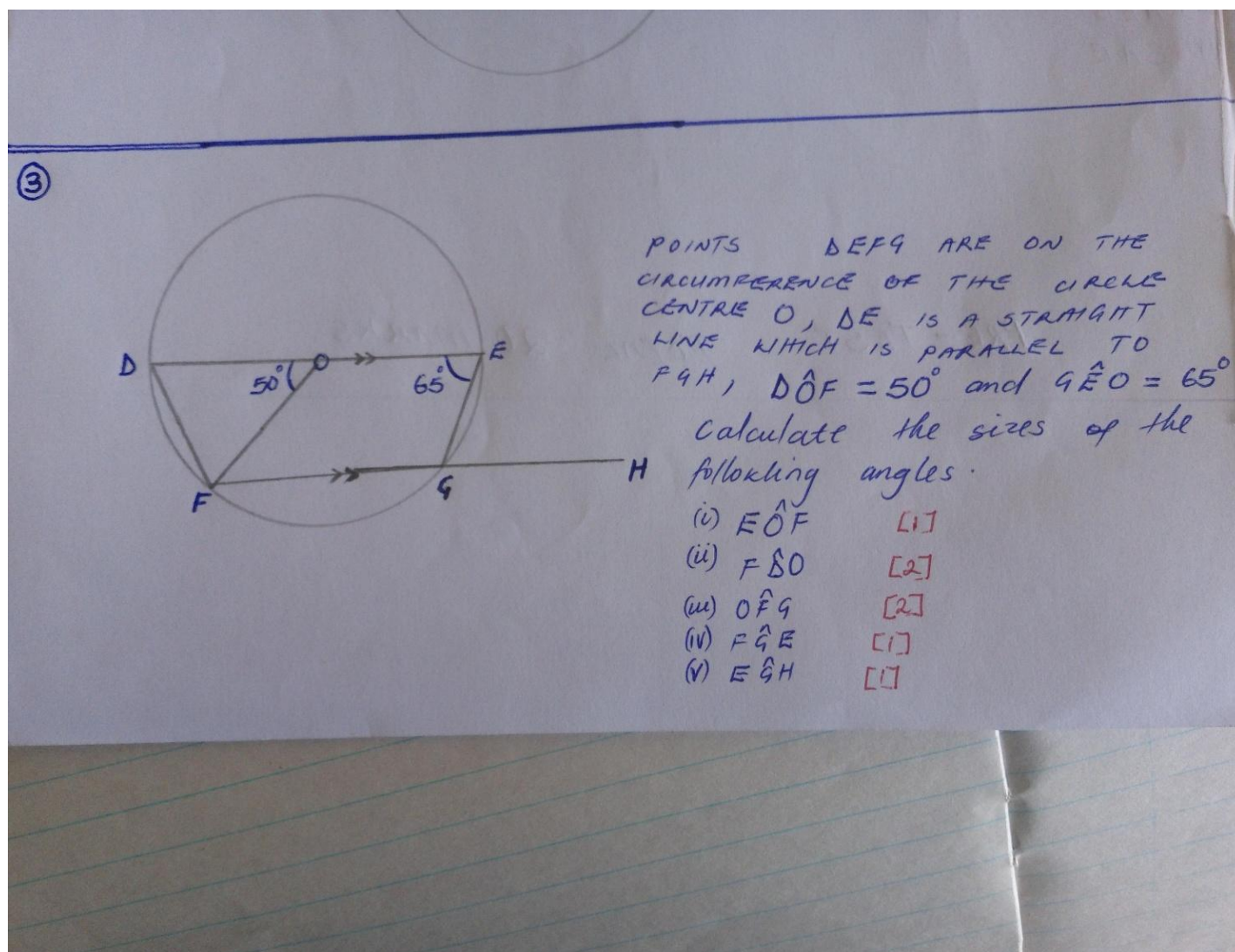


The above given is a solution given by student K in one of the questions given in the circle geometry test and from the results it shows that the learners knows the concept but the learner fails to apply it correctly the question was given as follows

4.5.3 Problem-Solving Strategies

Learners are also facing a challenge in developing effective problem-solving strategy. Circle geometry problems require learners to identify relevant information, develop a solution plan, and execute the plan correctly. However, learners are struggling to develop these skills, leading to difficulties in solving circle geometry problems for example on the given test some of the learners failed to draw and label the circle diagrams correct which leads to provision of incorrect answers

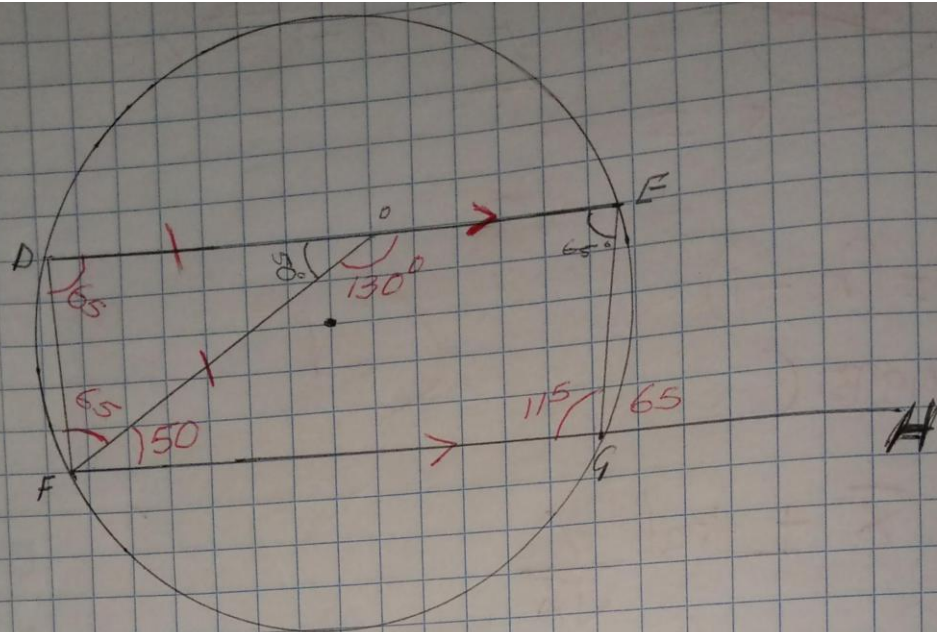
to the given problems the diagram below shows one of the questions given to learners and one of answers provided.



Below is one of a given solution by one of the learners in a geometry test

The Solution of the question was wrong due to lack of problems solving skills such as drawing since the diagram below was drawn wrongly the diameter DE was not on the correct position which complicates the problem thereby leading to errors by students in problem solving , also the absence of indicator of parallel lines DE and FGH which will also complicates problem solving so from this observation that learners lack problem solving skills

3



(i) $\angle EOF = 180 - 65$

(ii) $\angle FDO$

$= 115$ opposite angle of a quadrilateral are
add up 180°

$180 - 50 = 130^\circ$ adjacent angles on
straight lines

ii $\angle FDO = 50$ base angles of an isosceles triangle
are equal

draw your diagram properly O
should be at the centre of your circle.
 $\angle FDO = \angle FEO$

iii $\angle OFG = 115^\circ$ opposite angles of a cyclic quadrilateral
are add up to 180°

OFGE is not a cyclic quadrilateral but
EDFG is a cyclic quadrilateral so
it should be $115^\circ - 65^\circ = 50^\circ$

4.6 WHAT ARE THE CAUSES OF THOSE CHALLENGES.

4.6.1 Frustration or anxiety by learners on the topic circle geometry.

Circle geometry is a complex and challenging topic for many learners, often leading to feelings of frustration and anxiety. The root cause of these emotions can be attributed to several factors, including difficulty in grasping underlying concepts and theorems, pressure to meet expectations, teacher-related factors, and environmental influences.

The effects of frustration and anxiety in circle geometry can be detrimental to learner's academic performance and overall well-being. Decreased motivation and engagement, reduced performance and achievement, and negative impacts on self-esteem and confidence are just a few of the potential consequences.

4.6.2 Lack of teaching and learning resources

From the survey questionnaire the unavailability of teaching and learning resources lead learners to face significant challenges in solving circle geometry problems due to the lack of adequate resources. The lack of teaching and learning resources, including textbooks, digital resources, geometric instruments, and hands-on learning opportunities, hinders learners' understanding of complex circle geometry concepts. Without visual aids and interactive resources, learners struggle to visualize and explore geometric shapes and relationships, leading to poor retention and understanding. This, in turn, affecting their problem-solving skills and overall performance in circle geometry assessments and tests.

The impact of inadequate resources on learner performance is multifaceted. Learners experience difficulty applying circle geometry concepts to real-world problems, and their development of problem-solving skills and critical thinking is limited. Moreover, the lack of resources leads to frustration and disengagement, negatively affecting learner's overall mathematics achievement and confidence.

4.6.3 Very poor teacher support

Teacher support plays a very important role in shaping learner's understanding and performance in mathematics, particularly in circle geometry. Unfortunately, many learners face significant challenges in solving circle geometry problems due to poor teacher support, from the survey questionnaire some learners points that there is very poor teacher support at Gozi secondary which is hindering their success in comprehending or understanding circle geometry concepts. When teachers fail to provide clear explanations and examples, learners struggle to understand complex circle geometry concepts and theorems. Insufficient feedback and guidance further exacerbate the problem, leaving learners feeling lost and unsupported in the learning process. The unavailability of teachers to answer questions and provide support is hindering learner's progress, making it difficult for them to develop problem-solving skills and critical thinking. The impact of poor teacher support on learner performance is multifaceted. Learners experience poor performance in circle geometry assessments and tests, and their ability to apply circle geometry concepts to real-world problems is limited, moreover, the lack of support leads to limited confidence and motivation to learn circle geometry, negatively affecting learners' overall mathematics achievement and confidence.

4.7 WHAT CAN DONE BE TO REDUCE THESE CHALLENGES

4.7.1 Use of a variety of teaching approaches

To reduce frustration or anxiety by learners on the topic of circle geometry, teachers can use a variety of approaches. Providing clear explanations and examples, offering individualized support and feedback, and encouraging active learning and exploration can help learners build confidence and develop a deeper understanding of the topic. Additionally, teachers can use visual aids and technology to make the learning experience more engaging and interactive. By creating a supportive and encouraging learning environment, teachers can help learners overcome their fears and anxieties and develop a positive attitude towards circle geometry.

4.7.2 Providing adequate teaching and learning resources

The lack of teaching and learning resources is another significant challenge in teaching and learning circle geometry. To address this issue, schools and teachers can provide adequate resources, including textbooks, digital resources, and geometric instruments. Teachers can also use online resources and educational software to supplement their teaching and provide learners with interactive learning experiences. Furthermore, teachers can encourage learners to use technology to explore and visualize geometric shapes and relationships, making the learning experience more engaging and effective.

4.7.3 Providing regular feed back and guidance

Very poor teacher support is another challenge that is hindering learner's progress in circle geometry at Gozi secondary .To address this issue, teachers should provide regular feedback and guidance to learners, identify and address learner's misconceptions and difficulties, and use learner-centered approaches to promote engagement and understanding. Teachers should also work collaboratively with their colleagues to share best practices and resources, and

engage in ongoing professional development to enhance their knowledge and skills in teaching circle geometry.

4.8 CHAPTER SUMMARY

In conclusion, learners face significant challenges when solving circle geometry problems, including conceptual understanding, applying theorems and formulas, and problem-solving strategies. To overcome these challenges, learners must develop a deep understanding of circle properties and relationships, practice applying theorems and formulas, and develop effective problem-solving strategies, acknowledging these challenges and providing targeted support, educators can help learners improve their skills and confidence in solving circle geometry problems.

Chapter 5: SUMMARY, CONCLUSIONS AND RECOMMENDATION

5.1 Introduction

This chapter concludes the research investigation into the challenges faced by learners when solving problems of circle geometry at ordinary level, with a specific focus on form 4 learners at Gozi secondary school in Mudzi district. The study aimed to identify the difficulties learners encounter and explore the underlying factors contributing to these challenges. This chapter summarizes the key findings, provides recommendations for educators and policymakers, and offers concluding remarks.

5.2 Summary

The study revealed that learners face significant challenges when solving circle geometry problems, including understanding circle theorems, applying formulas, and visualizing problems. These findings are consistent with previous research, which highlights the complexities of circle geometry and the need for learners to develop a deep understanding of geometric properties and relationships. The study also identified limited resources and inadequate teacher support as contributing factors to learners' difficulties, underscoring the importance of effective teaching methods and resource availability.

5.3 Conclusion

In conclusion, the challenges faced by learners when solving circle geometry problems are complex and multifaceted. To address these challenges, educators and policymakers must work together to provide targeted support and resources, enhance teacher knowledge and skills, review and develop the curriculum, and use effective assessment strategies. By doing so, learners can

develop a deeper understanding of circle geometry and improve their ability to solve problems related to this fundamental area of mathematics.

5.4 Recommendations

Based on the findings of this study, the following recommendations are made.

Teachers should provide targeted support and resources to help learners overcome their challenges in circle geometry. This can include additional practice exercises, visual aids, and technology-enhanced learning activities .

Educators should receive training and development opportunities to enhance their knowledge and skills in teaching circle geometry. This can include workshops, mentorship programs, and peer coaching.

The curriculum should be reviewed and developed to ensure that it provides a comprehensive and coherent approach to teaching circle geometry. This can include incorporating real-world applications and technology-enhanced learning activities.

Teachers should use a range of assessment strategies to provide learners with feedback on their understanding of circle geometry. This can include formative assessments, peer assessment, and self-assessment.

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APPENDICES
LEARNER'S QUESTIONNAIRE

Section A: Background Information

1. What is your age?
2. What is your gender?
3. How would you rate your understanding of circle geometry? (Scale: 1-5, where 1 is "very poor" and 5 is "excellent")

Section B:

Challenges in solving circle geometry problems

1. Which aspects of circle geometry do you find most challenging? (Select all that apply)

Understanding circle theorems

Applying formulas (e.g., circumference, area)

Solving problems involving angles and arcs

Visualizing circle geometry problems

Other (please specify)

2. What difficulties do you face when solving circle geometry problems? (Select all that apply)

Lack of understanding of concepts

Insufficient practice

Difficulty with problem-solving strategies

Limited resources (e.g., textbooks, online materials)

Other (please specify)

3. How often do you experience frustration or anxiety when solving circle geometry problems?

Always

Often

Sometimes

Rarely

Never

1. How would you rate the support you receive from your teacher in learning circle geometry?
(Scale: 1-5, where 1 is "very poor" and 5 is "excellent")

2. What resources do you use to learn circle geometry? (Select all that apply)

Textbooks

Online materials

Educational videos

Practice exercises

Other (please specify)

3. Are there any additional resources or support that you think would help you improve your understanding of circle geometry? If yes, please specify.

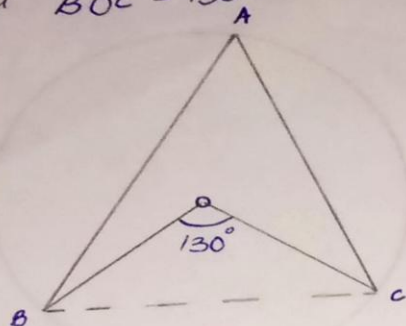
Section D:

Open-ended questions

1. What specific topics or concepts in circle geometry do you struggle with the most?
2. How do you think your teacher or school could better support you in learning circle geometry?
3. Do you have any suggestions for improving your understanding of circle geometry?

GEOMETRY TEST THAT WAS ADMINISTERED TO LEARNERS

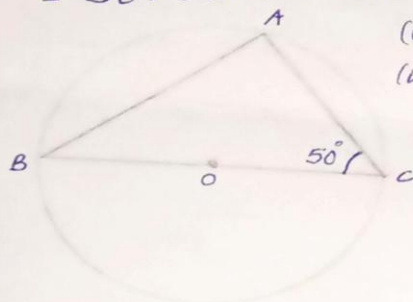
1. The diagram below shows a circle centre O with A , B and C on the circumference of the circle and $\angle BOC = 130^\circ$



(a) Calculate the size of the following angles.

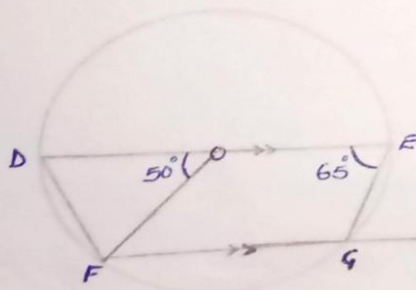
- (i) $\angle BAC$ [1]
 (ii) $\angle ABC$ [1]
 (iii) $\angle ACO$ [2]

2. The diagram below shows a circle centre O with A , B and C on the circumference of the circle, $\angle ACB = 50^\circ$. Calculate the sizes of the following



- (i) $\angle BAC$ [1]
 (ii) $\angle ABC$ [1]

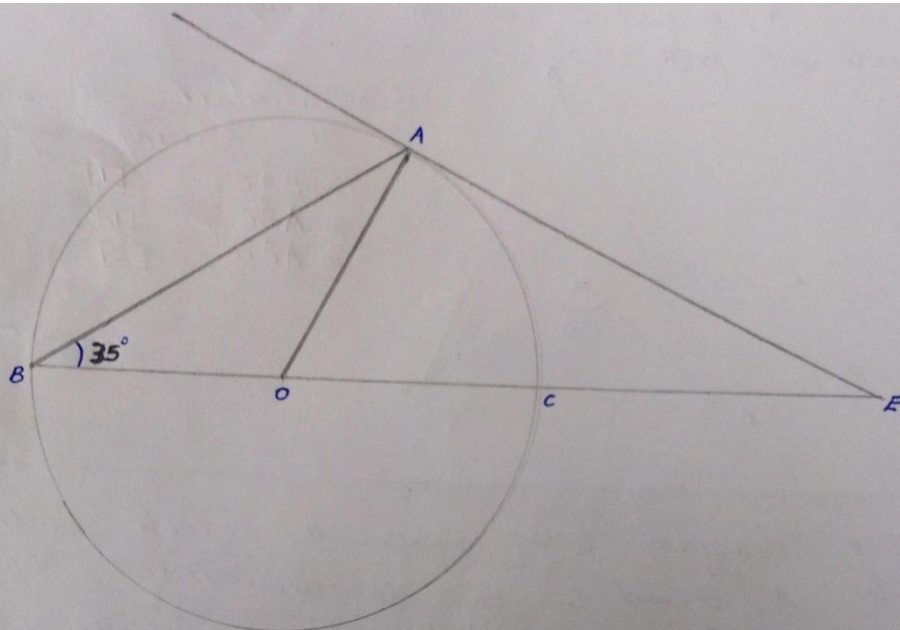
③



POINTS D, E, F, G ARE ON THE CIRCUMFERENCE OF THE CIRCLE CENTRE O , DE IS A STRAIGHT LINE WHICH IS PARALLEL TO FGH , $\angle DOF = 50^\circ$ and $\angle GEO = 65^\circ$

Calculate the sizes of the following angles.

- (i) $\angle EOF$ [1]
 (ii) $\angle FGO$ [2]
 (iii) $\angle OFG$ [2]
 (iv) $\angle FGE$ [1]
 (v) $\angle EGH$ [1]



The diagram above shows points A, B and C on the circumference of the circle centre O, BCE is a straight line and AE is a tangent to the circle at A, $\angle ABO = 35^\circ$. Calculate.

- (i) $\angle OAE$ [1]
- (ii) $\angle AOC$ [2]
- (iii) $\angle AEB$ [2]
- (iv) $\angle BAE$ [2]