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AN ASSESSMENT ON DIFFERENTIATED INSTRUCTION IN MATHEMATICS AT ORDINARY LEVEL

BY

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Title of the dissertation: An assessment on differentiated instruction in mathematics at ordinary level

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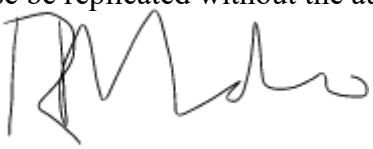
Signed: 

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DEDICATION

I would like to dedicate this study to my lovely parents who encouraged me through all circumstances to reach this far. To my children Blessed, Shelter and Roman you are the reason I thrived on when it became tough. To my dear friends and colleagues I am thankful for the words of encouragement you have given me.

ABSTRACT

The study ought to assess the implementation of differentiated instruction in the teaching of mathematics at the ordinary level. The research was motivated by the increasing student diversity in classrooms and the need to improve student engagement and performance in mathematics. Data was collected through questionnaires, interviews, and classroom observations involving mathematics teachers and students in selected secondary schools. The findings revealed that while teachers are aware of differentiated instruction, its application remains inconsistent due to challenges such as large class sizes, limited resources and lack of professional training. Students expressed a preference for instructional methods that cater to their readiness levels, learning styles, and interests. The study concludes that differentiated instruction has the potential to enhance learning outcomes in mathematics when effectively implemented. Recommendations include increased teacher training, provision of teaching resources, and curriculum flexibility to support differentiation practices. The study contributes to improving inclusive pedagogical strategies and supports the use of differentiated instruction as a tool for equity and effectiveness in mathematics education at the secondary school level.

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CHAPTER ONE

THE PROBLEM AND ITS SETING

1.1 Introduction

Differentiated instruction is an instructional approach that is designed to address diverse needs of students by modifying content, product and learning environment. The study aimed to outline the background to the study, the statement of the problem, purpose, research objectives and questions and significance of the study of assessing how differentiated instruction is applied in mathematics classrooms at ordinary level.

1.2 Background to the study

There is growing recognition that learners have diverse abilities, learning styles, and needs. Tomlinson (2017) defines differentiated instruction as a teaching philosophy that acknowledges these differences and promotes a flexible teaching approaches to meet varied learner needs. Differentiated instruction has emerged as a powerful strategy to address these differences, which often present learning challenges, particularly in mathematics. Mathematics is a core subject in Zimbabwe's ordinary level curriculum, yet it remains one of the most failed subjects recording low pass rates partly due to rigid and uniform teaching methods (ZIMSEC, 2022). Teachers often use a one-size-fits-all approach, which does not cater to the diverse capabilities of learners. However, Suprayogi, Valcke & Godwin (2017) state that when instruction, content and assessment are adapted to individual learner needs, it can enhance understanding and academic performance. There is limited research on how effectively differentiated instruction is applied in Zimbabwean mathematics classrooms, despite its theoretical benefits, especially at the secondary school level. This study aims to assess the implementation and effectiveness of differentiated instruction in ordinary level mathematics classrooms.

1.3 Statement of the problem

Although differentiated instruction has been widely advocated in educational policies and training, its practical application in ordinary level mathematics classes remains unclear. Many learners continue to struggle, suggesting a gap between theory and classroom practice. This research seeks to evaluate how differentiated instruction is implemented and its impact on learner outcomes in mathematics. The researcher identified that reaching every student in an inclusion classroom was the problem and several behaviors were observed that could define multiple abilities in the classroom as a problem. Therefore, the researcher aimed to assess how differentiated instruction will be applied in ordinary level mathematics and its impact on student performance and classroom inclusion.

1.4 Research Questions

1.4.1 What is the impact of differentiated instruction on student learning outcomes in mathematics?

1.4.2 What strategies do teachers employ to implement differentiated instruction in mathematics?

1.4.3 How do students perceive differentiated instruction in their mathematics classes?

1.4.4 What challenges do teachers face when implementing differentiated instruction in mathematics?

1.5 Research Objectives

1.5.1 Evaluate the effectiveness of differentiated instructions.

1.5.2 Investigate student engagement and motivation.

1.5.3 Explore challenges faced by students.

1.5.4 Analyse teacher implementation strategies.

1.6 Significance of the study

The study intended to equip the researcher with necessary differentiated instructions in mathematics at ordinary level. The study provided differentiated instructions that are fundamentally about tailoring teaching methods to meet the diverse needs of students. As students are more likely to be motivated and perform better academically when they are taught in ways that concord with their individual learning preferences, the study provided an insight into factors that enhance student engagement and achievement. A valuable contribution was made from this study as the outcome suggested better and improved ongoing assessment and flexible grouping that helped the researcher towards effective teaching of mathematics and provided insight into effective instructional practices in mathematics at ordinary level. This was achieved by grouping students based on their learning profiles. This aligns with Tomlinson (2017), who emphasizes that differentiated instruction when informed by continuous assessment and responsive grouping can significantly improve student outcomes and instructional quality in diverse classrooms. These strategies can guide mathematics teachers to meet diverse student needs, thereby promoting better student engagement and achievement. It also contributed to the improvement of teaching strategies and learner outcomes, ultimately supporting national education goals. Five dimensions of differentiation were adapted from Renzuli & Reis (2014) to differentiate he curriculum to meet the academic needs of students such as content, instructional strategies, classroom, products and the teacher. The researcher also discussed challenges and solutions about how differentiation can be implemented.

1.7 Assumptions of the study

The researcher had the following assumptions:

Learners have diverse needs and learning styles.

Differentiated instruction improves student engagement and performance.

Teachers require professional competence to differentiate to differentiate and assess effectively.

Classroom context influences implementation and assessment.

Assessment must align with differentiated practices.

1.8 Delimitation

The research was carried out at schools in rural area in Makoni in Manicaland province. The study was conducted to assess the impact of differentiated instructions in terms of secondary school student's academic achievement and attitudes in the context of the learning of mathematics at ordinary level. The research concentrated on certain differentiated instructional strategies while excluding others. Also, the assessment utilised specific tools or methods for evaluating student performance and engagement such as interviews, tests and observation among others. However, barriers such as large class sizes, lack of training, and rigid curricula hinder its implementation. The study was limited to select secondary schools in one district and only ordinary level mathematics was considered. As a result, this shaped the conclusions drawn about the overall effectiveness of differentiated instructions.

1.9 Limitations

Due to external factors such as socio-economic status, parental involvement and school resources, student performance and engagement was affected. On the other hand, teacher training and implementation could not accurately reflect the potential benefits of differentiated instructions if they lack adequate training or support. Time constraints also limited the study. A short time frame could not allow for a comprehensive assessment of the long-term impacts of differentiated instructions on student learning and retention of mathematical concepts.

1.10 Definition of key terms

Renzuli (1977), Tomlinson, (2000), define differentiation is an attempt to address the variation of learners in the class through multiple approaches that modify instruction and curriculum to match the individual needs of students.

Differentiated instruction is a teaching strategy that involves adjusting content, process, product, or learning environment to meet the diverse needs, interests, and abilities of students (Tomlinson, 2017).

1.11 Conclusion

This study has introduced the concept of differentiated as a strategy to address student in mathematics learning. The chapter outlined the research problem, statement of the problem, research objectives and significance of the problem. It sets the foundation for assessing the effectiveness and practical application of differentiated instruction in improving student outcomes in ordinary level mathematics.

CHAPTER 2

REVIEW OF RELATED LITERATURE

2. 0 Introduction

This chapter reviews related literature on the enhancement of the performance of students in mathematics at ordinary level, exploring the strategies, concept, benefits and challenges on student performance. The purpose of this chapter therefore, is to analyse the opinions of different authors on assessing differentiated instruction in mathematics at ordinary level. Various teaching strategies and assessment tools have been applied in the context of renewed curricula in order to enable learners to make their own decisions, solve problems and develop as thinking individuals in the educational process (Gregory &Chapman, 2014).

2.1 Interpretation and evaluation of literature

Differentiated instruction is an approach that acknowledges the varied readiness levels, learning preferences and interests of students. This approach helps to cater to both advanced and struggling students in mathematics at ordinary level. Tomlinson & Imbeau (2010) emphasise that differentiation instruction in mathematics requires teachers to modify content process and product to ensure all learners engage meaningfully. They stress the importance of ongoing assessment as a core element in shaping differentiated tasks. Mpofu (2021) found that secondary teachers view differentiated positively but often struggle with Implementation due to large class sizes and limited resources. Chamberlin & Power (2010) highlight that in mathematics tiered instruction and flexible grouping improve learner engagement and performance when paired with continuous formative assessment. Differentiated strategies in Zimbabwean schools were more effective when aligned with ongoing diagnostic assessment. The literature supports the effectiveness of differentiated instruction in mathematics at the ordinary level, particularly when informed by regular purposeful assessment. However, challenges in implementation especially in resource, limited contexts like Zimbabwe call for practical teacher support and policy adjustments. Mpofu (2021) and Matsika (2019) provide contextual relevance to Zimbabwe, making their contributions more applicable to ordinary level mathematics in local schools. While most researchers agree on the benefits of differentiated instruction, they also acknowledge challenges such as inadequate teacher training, limited teaching time and rigid curricula (Chamberlin in Power, 2010). The reviewed literature collectively highlights the critical role of assessment in successful differentiation. Therefore, teachers who continuously assess are more likely to adjust their teaching to meet student needs effectively.

2.2 Problem establishment

In many Zimbabwean ordinary level mathematics classrooms, uniform teaching methods are applied despite student diversity. Teachers often do not use ongoing assessment to inform instruction which limits their ability to meet individual learning needs. For example, in a class of fifty-four students, a teacher might give the same task to all students regardless of prior knowledge, leaving students with low level of readiness behind and those with high level of readiness unchallenged. As a result, students who are either struggling or excelling may become disengaged. Teachers rely on formative assessment such as observation or class tasks to guide instruction. Assessment data is often underutilized in planning differentiated activities or interventions. There is need for improvement because without informed differentiated instruction, students at risk, continue falling behind. As a result, teachers need supportive strategies and tools to assess learning continuously and tailor instruction accordingly.

In addressing this problem, questionnaires were used to gather data from mathematics teachers on how they assess students and apply differentiated instruction. Also classroom observation to see real time use of differentiated strategies and assessment methods. There was need to analysing the gap between theory and practice in applying assessment for differentiated.

Many students in ordinary level mathematics perform at varying levels while teachers often use a one-size-fits-all approach ignoring student diversity. Also, there is limited use of assessment to inform differentiated instruction strategies. Despite the growing emphasis on inclusive education, mathematics instruction at the ordinary level in many Zimbabwean. Structuring refers to organizing content in a clear, coherent, and purposeful way, while logical sequencing ensures that each idea builds on the previous one to support understanding and flow. In teaching mathematics through differentiated instruction, this is critical for meeting diverse learner needs. Students learn better when lessons are structured in a way that moves from known to unknown, simple to complex, or concrete to abstract. Tomlinson (2014) emphasizes that logical sequencing of differentiated tasks helps students make meaningful connections in learning. Sequencing by readiness in teaching algebra, start with basic operations that is adding or subtracting integers followed by solving simple equations and applying equations to word problems as well as

extension tasks for advanced students for instance, solving simultaneous equations. This ensures students at different levels progress appropriately. Foundational knowledge is built progressively reducing cognitive overload for struggling students. Advanced students are challenged and engaged during learning and assessment of progression is supported.

The question now is how and why certain differentiated instruction methods are used. Thus using manipulatives in geometry allows visual students to grasp abstract concepts more easily. Therefore, when properly implemented, differentiated instruction enhances concept mastery across readiness levels. Foundational knowledge is built progressively reducing cognitive overload for struggling students. Advanced students are challenged and engaged during learning and assessment of progression is supported. The question now is how and why certain differentiated instruction methods are used. Thus using manipulatives in geometry allows visual students to grasp abstract concepts more easily. Therefore, when properly implemented, differentiated instruction enhances concept mastery across readiness levels.

2.3 What is the impact of differentiated on student learning outcomes in mathematics?

Research shows that differentiated instruction enhances conceptual understanding, learner engagement and academic performance (Chamberlin & Power, 2010). Implementation of differentiated instruction impacts student outcome in ordinary level mathematics. Teacher and student perceptions in differentiated instruction play a role in understanding its effectiveness and feasibility. Studies suggest a positive relationship between differentiated instruction and improved academic achievement. The researcher noticed that students show more interest when teaching is adapted to their needs. Student engagement improved following an increase in student motivation and participation. For example, when a teacher uses real life scenarios like calculating profit and loss during shopping, students who are interested in money making become more involved in solving percentage problems. Tomlinson & Imbeau (2010) state that matching instruction to learner boosts engagement and classroom participation. Hall, Strangman & Meyer (2011) posit that differentiated instruction leads to improved mathematical understanding and better student attitudes. Students grasp mathematical concepts better when

instruction is adapted to their learning pace and style. Since students have different strengths and ways of processing information, multiple intelligences challenge the traditional view of intelligence as a measurable entity which helps teachers to offer diverse pathways for students to learn and demonstrate understanding beyond logical-mathematical approaches. For instance, students choose to demonstrate understanding of area through verbal explanation, using formulas and drawing thereby building ownership of learning. The researcher noted that students developed confidence and direction when they were given choice and challenging tasks. The goal of differentiation in mathematics instruction is to provide multiple entry points and pathways of learning for a given concept. Having such flexible problem solving strategies enables students to approach increasingly complex problems with confidence and a richer conceptual understanding.

Several studies suggest a positive correlation between differentiated instruction and improved academic achievement. For instance, a meta-analysis by Smale-Jacobse et al. (2019) found a small but significant positive effect of DI on academic outcomes across various subjects. Specifically in mathematics, research by Baumgartner et al. (2013) indicated that students in differentiated classrooms showed greater gains in mathematical understanding compared to those in traditional settings. However, other studies have reported less conclusive results, often attributing this to inconsistent or partial implementation of differentiated instruction (Morgan, 2014). The effectiveness appears to be highly dependent on the fidelity and quality of implementation.

Differentiation, by catering to student interests and learning profiles, is theorized to enhance engagement and motivation. When students feel that their learning needs are being met and they have some choice in their learning, they are more likely to be intrinsically motivated (Deci & Ryan, 2000). Research by Bondie et al. (2019) found that differentiated classrooms fostered higher levels of student participation and enthusiasm. In mathematics, where some students may experience anxiety, differentiated approaches can reduce frustration and build confidence, thereby increasing engagement (Boaler, 2016). Organize learners into changing groups based on topic or ability. Group A students works on basic operations, while those in group Group B solves word problems involving percentages. The researcher provided a flexible, supportive and respectful classroom atmosphere that is conducive for individual needs like seating arrangements

and creating opportunities for collaborative work. A positive attitude towards mathematics is crucial for long-term success and continued learning in the subject (Tapia & Marsh, 2004). Differentiated instruction, by making mathematics more accessible and relevant to individual students, can foster more positive attitudes. When students experience success and feel supported, their self-efficacy in mathematics tends to improve, leading to a more favorable disposition towards the subject (Bandura, 1997). Studies have shown that students in differentiated settings often report feeling more capable and less anxious about mathematics (e.g., Tomlinson, 2014). Therefore, diverse learning needs is supported as differentiated instruction allows teachers to address the needs of both students with low level of readiness and those with high level of readiness within the same learning environment. Differentiated instruction enables inclusive education by ensuring no learner is left behind (Mpofu, 2021). The use of differentiated instruction allows teachers to adjust pacing and sequence to meet learner needs. Give more time to concepts like probability if learners show difficulty. Ministry of Primary and Secondary Education (2015) supports learner-centered approaches under Zimbabwe's curriculum framework. For mathematics, this might include creating concept map, solving a complex problem, designing a presentation or building a model rather than relying on traditional tests (Tomlinson & Imbeau 2010).

2.4 What strategies do teachers employ to implement differentiated instruction in mathematics?

Wright (1987) asserts that teaching and learning aids provides a variety of tools in the hands of the teacher. Teachers can therefore make use of teaching and learning aids in a diversity of ways in order to promote active learning. Good teaching should involve presenting the learners with situations in which they experiment and manipulate concrete objects as learning aids. In this case the researcher urged every learner to make a model of a watch for demonstration during lessons. What bridges the gap between theory and practice is instructional media. Mathematics teachers have to use instructional media to provide learners with situations near to reality. The abstract geometrical concepts are made concrete when learners see and do some activities using real objectives like a protractor. Mwamwenda (2004) asserts that teachers should come up with motivational techniques that stimulate learners` interests to participate. He went on to say that by

motivating learners, participation increases as motivation triggers the psychological drive or stimuli in learners to have a positive attitude to the subject matter Differentiated instruction in Mathematics at Ordinary level has been a topic of interest among educators. Research suggests that tailored approaches can improve student outcomes, particularly for those with diverse learning needs (Tomlinson, 2001). Studies have shown that differentiated instruction can enhance student engagement, motivation, and overall mathematics performance (Hall, 2002; Housand & Housand, 2008). However, effective implementation requires careful planning, ongoing assessment, and teacher support (Wiggins & McTighe, 2005). In terms of implementation, Wiggins and McTighe (2005) emphasize the importance of backward design, where teachers start with clear learning goals and then design instruction to meet those goals. This approach allows teachers to differentiate instruction based on student needs and abilities.

Training teachers on differentiated instruction strategies like tiered tasks, flexible grouping, and readiness assessments improve the effectiveness of differentiated instruction in mathematics. Workshops on how to design multi-level activities in algebra or geometry. Tomlinson & Imbeau (2010) emphasize that teacher preparedness is key to effective differentiated instruction. The use of diagnostic assessments by conducting pre-assessments to determine students' readiness, learning profiles, and prior knowledge. This means that before starting equations, teachers assess whether they understand basic operation. More recent studies have also highlighted the benefits of differentiated instruction in math education. For example, a 2018 study by Almarzooqi and Abdelraheem found that differentiated instruction significantly improved math achievement and reduced math anxiety among students with learning difficulties (Almarzooqi & Abdelraheem, 2018). Another study by Çakıroğlu and colleagues (2020) found that differentiated instruction enhanced math achievement and motivation among students with different learning styles (Çakıroğlu et al., 2020). For example, when working on properties of triangles students were grouped according to their level of readiness. Those with low level were asked to identify types of triangles, each triangle and state its properties. This was done with the aid of visual aids and real life examples like road signs. Those with medium readiness were asked to calculate missing angles using sum rules The other group of students with high level were asked to apply triangle properties to solve complex problems. Low readiness students built confidence by starting with visual and hands on tasks. This offered challenge to advanced students through application and problem solving. This encouraged conceptual understanding beyond rote memorization.

The purpose of the research was to increase mathematical performance in a varied ability math classroom. Our post-documentation data was looking to validate the fact that multiple abilities existed in the classroom and the challenges this presented for inclusion teachers. The problem of varied abilities appeared to be an issue among the four teacher researchers.

2.5 How do students perceive differentiated instruction in their mathematics classes?

Mathematics success in the classroom is related to attitude towards mathematics. In order for students to learn best, differentiated instruction is to present teaching in accordance with learning differences. For language skill, I noted that students lacked understanding of the mathematical language. These lacking caused obstacles in understanding the objective of mathematics concepts that affected the ability to solve the problem. Language and visual-spatial skills help to interpret and manipulate information effectively in the working memory (Geary, 2004). When students experience success and feel supported, their efficacy in mathematics tends to improve, leading to a more favourable disposition towards the subject (Bandura, 1997). Deci and Ryan (2000) also support that when students feel that their learning needs are being met and they have some choice in their learning, they are more likely to be intrinsically motivated. Students showed interested and were more likely to engage when teaching was adapted to their needs. Hall, Strangman & Meyer (2011) suggest that differentiated instruction leads to improved mathematical understanding and better learner attitudes. Piaget (1950) and Vygotsky (1978) posits that learners actively construct their own understanding and knowledge of the world through experiencing things and reflecting on those experiences. Teachers provide varied opportunities for students to engage with content and build knowledge in meaningful ways to them. The concept of the Zone of Proximal development by Vygotsky is relevant in suggesting that learning occurs most effectively when students are challenged beyond their current independent capabilities with appropriate scaffolding. This is a cognitive development that refers to a range between what a student can do without help and what they can achieve with guidance and encouragement from a skilled personnel. If done properly, differentiated instruction provide varied levels of support and challenge.

The way in which the van Hiele levels are numbered has varied (Clements & Battista, 1992). For the purpose of this paper, the first three levels are listed. The terms visualization, analysis, and informal deduction describe the cognitive levels through which the learners progress (De

Villiers, 1987; Hoffer, 1981; Teppo, 1991). *Level 1 (Visualization):* Learners at this initial level identify, name, compare, and operate on shapes and other geometric configurations according to their appearance. Figures are seen as visual shapes in that individual attributes, such as angle measure, are not explicitly recognized; instead the figures are considered as a collection of a whole. Perception guides the learners' reasoning, and visual prototypes are typically used to name a figure. For example, a learner may say that a figure is a rectangle because it looks like a door (Clements, 1998). *Level 2 (Analysis):* At this level learners have progressed from shape perceptions to analysing figures according to their attributes and are able to identify the relationships among the attributes to discover rules for how figures are named. For instance, a learner may think of an equilateral triangle as a figure with three equal angles; therefore, the learner has learned that the term "equilateral triangle" refers to a specific collection of properties. *Level 3 (Informal Deduction):* Learners can provide abstract definitions and informal arguments at this stage. They can distinguish between the necessity and sufficiency of a set of properties for a concept, while also ordering those properties logically. It becomes clear, for example, why a square can also be a rectangle. Although the learners are showing a method of logical organization, they do not know that it is a method by which geometric truths are established.

Students' perceptions of differentiated instruction in mathematics vary depending on how it is implemented. However, in most ordinary level settings, especially in Zimbabwe, students generally have positive perceptions when learning is more understandable though there is a belief that mathematics is a difficult learning area. Students feel that when teachers use varied methods such as visual aids, practical examples, they understand difficult concepts better. A student who struggles with algebra appreciates when the teacher uses step-by-step visuals or manipulatives. Students perceive that learning is fair and inclusive. They feel included when tasks match their ability and pace, making mathematics less intimidating. Students with low level of readiness feel more confident working in small and supportive groups. Differentiated instruction builds self-esteem as students' experience success in tasks designed for their level. Mpofu (2021) found that students perceived differentiated instruction as encouraging because it reduced fear of failure. When mathematics is connected to real-life or students' interests, it feels more relevant and enjoyable. Using shopping scenarios to teach percentages appeals to commerce-oriented learners. Therefore, students' perception towards differentiated instruction in mathematics.

On the other hand, when poorly implemented differentiated instruction has negative perceptions to students. Some students dislike being placed in lower groups, feeling labeled as slow. A student in a remedial group may feel inferior if groupings are permanent and obvious. If instructions or tasks vary too much without clear guidance, students feel lost or overwhelmed, giving a room for high achievers may feel overburdened if given more complex tasks without adequate support. Some enjoy collaborative problem-solving while others prefer working alone, especially if group dynamics are poor.

2.6 What challenges do teachers face when implementing differentiated instruction in mathematics?

Among the problems facilitating learners' performance, school-related variable such as class size and learner-related such as peer pressure would be viewed.

2.6.1 Class size

The relationship between the size and learners' achievement is not well defined for classes with 20-40 students as observed by (Liethwood, 2019). There was an agreement on the fact that large classes make it difficult to practicalise geometry. The result above was supported by Ijaya (2000) who said that large classes renders a burden on the teacher for marking daily exercises hence delays feedback. In my observation dealing with a large class size especially when measuring angles using a protractor, there is need to facilitate each student whereby some have negative attitude to learning new things and it also needs enough time to cater for each individual for a better understanding. The relationship between the class size and learner's performance is so advantageous for small class size facilitate interaction and hold back teacher specialization. Nyambuva (2004) observes that small class size makes the teacher work less strenuous and effective as opposed to large class size which may limit the teacher ability to cater for individual differences as well as proper class management. The researcher also noted that there was inadequate participation during lessons especially learners who sit at the back.

Teachers struggle to find a method of teaching to meet the diverse classroom needs because what works for some students does not work for others.as a result, creating an environment where all students' needs can be met with higher degree of accountability was a challenge since students have different learning styles, interests and level of readiness. This agrees with Treso (2004) who states that teaching to the middle of the class means that the students at the extreme ends are not having their educational needs met. That is, focusing on one particular level the other students' progress is disturbed. At the school wide level, there are many problems with both mixing all students together and separating students into tracks based upon ability. On the one hand, some argue that grouping all students into mixed ability classrooms does not challenge students enough (Cramond, Benson, and Martin, 2002). On the other hand, some will argue that tracking students does not necessarily guarantee all students' success either (Burris & Welner, 2005; DiMartino & Miles, 2005; Hallam, 2002; Lawrence-Brown, 2004).

2.6.2 Time constraints

Another problem with differentiation (or any teaching method) is keeping students actively engaged and interested in what they are learning, which is a challenge (Tomlinson, 2000). Developing intriguing and exciting lessons that peak the interests of a variety of students in one class can be a time consuming and difficult task for teachers. Some students simply may not be interested in the topic at hand and others may not be able to keep up with or comprehend what is being taught. If students' interests are not kept and there is too much repetition throughout multiple lessons, their talent may not be fully developed (Johnson, 2000). Planning time also is a challenge faced by teachers implementing differentiated instruction. Many teachers become overwhelmed and frustrated when thinking about the time and effort to plan differentiation (Powell & Napoliello, 2005; VanTassel-Baska & Stambaugh, 2005). Often there is a lack of planning time for teachers to make differentiation feasible (VanTassel-Baska & Stambaugh, 2005). There is no way around it, structuring differentiation in the classroomtakes planning and it needs to be reflected upon to be sure that quality work is being produced (Tomlinson, 2000). Many teachers see this as a major turn off to implementing differentiation because time is a major component and something they have very little of. Educators must find ways to provide excellence and challenge to all students (George, 2005) because research has shown that there

are discrepancies between what teachers feel are appropriate instructional activities for their students and what the students think about their own academic ability (Hallam, 2002).

2.6.3 Lack of training

The reason one-size-fits-all classrooms continue is that teachers lack the exposure and the knowledge to incorporate differentiated instruction (Edgemon, Jablonski & Lloyd, 2006; Holloway, 2000; Tomlinson, 2005). Practicing teachers need training on how to address the varying learning styles, interests, and abilities of the students in their classrooms so they can implement differentiated instruction (Pettig, 2000; Wehrmann, 2000; Tieso, 2004). Students need content for them to access the learning. Differentiation of content involves providing resources, varied materials and information to students based on their level of readiness or interest. Hall (2002) put forward that mathematics includes providing simplified texts for struggling learners, offering advanced problem-solving challenges for gifted students or using real-world examples that align with student interests. Regardless of the differences in student ability, teachers must hold themselves as well as their students responsible for learning in the classroom. Especially with the no child left behind law which is placing a great deal of pressure on teachers and school administrators to ensure that all students are successful students (VanSciver, 2005). Consequently, educators are increasingly faced with the challenge of creating an environment where all the needs of the students can be met with a higher degree of accountability (Ferguson, 1999; Greenspan, 2005; Tomlinson, 2000; VanTassel-Baska & Stambaugh, 2005).

2.7 Summary

This chapter has reviewed existing literature on differentiated instruction, focusing on its principles, strategies, benefits and challenges in the context of mathematics at the ordinary level. Major findings highlight that when properly implemented, differentiated instruction enhances student engagement, support diverse learning needs and improves performance mathematics. The previous research discussed provide a strong foundation for the present study. They guide investigation of how differentiated instruction is applied, how students and teachers perceive it and what factors influence its success or failure. The next chapter will present the methodology

used to collect and analyse data in assessing the actual practice of differentiated instruction in mathematics.

CHAPTR THREE

RESEARCH DESIGN AND METHODOLOGY

3.1 Introduction

This chapter presents the research design and methodology, research methods, population, sample sampling methods and research instruments. The data collection procedure outlines the systematic steps followed by the researcher to obtain reliable and valid data that address the research objectives and questions. Before data collection begins, teacher identifies the target population (e.g., mathematics teachers and students at ordinary level). Seeks ethical clearance from relevant authorities (e.g., school heads, education offices). Prepares data collection tools: questionnaires, interview guides, observation checklist.

3.2 Research design

Cresswell (2009) defines research design as a set of guidelines and instruments to be followed in addressing the research problem. The researcher used a case study which was associated with qualitative and quantitative methods and the study focused on differentiated instruction in mathematics at ordinary level. According to Yin (1984), a case study is an empirical inquiry that is used to investigate issues of concern within a real life context. The study adopted qualitative methods and the researcher used tests, interviews and participant observations. Quantitative data was accessed through questionnaires to assess the teaching approaches used by mathematics secondary school teachers in the teaching of geometry and cycles and participant observation to examine the causes of the problem and to establish possible solutions.

3.3 Population

A population is the entire group that a researcher intends to draw conclusions about (Creswell, 2008). In general, population refers to the whole group from which the researcher is able to get relevant information or data required for the research process. In this case the population consisted of one hundred students and the five mathematics teachers. The research also included male and female students.

3.4 Sample and Sampling Procedure

Mcmillan & Schumacher (2001), describes sample as the number of individuals selected from the larger population for the study. It is also referred to as a survey involving less than the whole population. One hundred students provided information representative of all students in five secondary schools as well as five teachers in the mathematics department at certain secondary schools. Simple random sampling was used to select learners who participated in the research. Simple random sampling is a procedure which provides equal opportunities of selection for each element in the population and the selection of one person is independent of the selection of another person (Gibson, Allen & Sturman 2001). The researcher wanted both sexes to be fairly represented in the sample. Upon carrying out the random sampling, the researcher wrote ‘yes’ on

fifty cards and ‘no’ on the rest of the cards for the boys to pick and the same was done for the girls. Those who picked a ‘yes’ automatically qualified to be in the sample. Fifty boys and fifty girls were therefore selected from the population. From the mathematics department, five teachers were consulted for the needed information.

3.5 Data collection instruments

This section outlines how the researcher intends to present and analyze the data collected during the study on differentiated instruction in mathematics at ordinary level. The study uses both qualitative and quantitative approaches, so both numerical and descriptive data will be considered.

Foundational knowledge is built progressively reducing cognitive overload for struggling students. Advanced students are challenged and engaged during learning and assessment of progression is supported. The question now is how and why certain differentiated instruction methods are used. Thus using manipulatives in geometry allows visual students to grasp abstract concepts more easily. Therefore, when properly implemented, differentiated instruction enhances concept mastery across readiness levels. This section outlines how the researcher intends to present and analyze the data collected during the study on differentiated instruction in mathematics at ordinary level. The study uses both qualitative and quantitative approaches, so both numerical and descriptive data will be considered. In a varied ability classroom a teacher needs to find ways to reach all learners. Many researchers believe that the best practice for accomplishing this task is differentiation. Differentiation is designing lesson plans, projects, assessments, and learning environments to accommodate the individual readiness, interests and learning profile of each student (George, 2005; Powell & Napoliello, 2005; Tomlinson, 1999; Tomlinson 2000; Tomlinson 2005). This does not mean that one group of students receives one curriculum and another group does not receive that curriculum. As a result of cooperative learning lessons, multiple intelligence based lessons, student choice of assignments, and differentiated assignments the students of teacher researchers A, B, C, and D, were to improve mathematic skills in a varied ability classroom. To implement the intervention for this research project, the teacher researchers focused on four areas of differentiation. First, teacher researchers developed cooperative learning lessons at each grade level. For example, teachers paired up high

and low level students and introduced a mathematics game to review money concepts. Secondly, multiple intelligence lessons were implemented in each classroom.

3.5.1 Tests

Tests provide measurable data to assess academic progress and help determine whether differentiated instruction enhances mathematical understanding (Fraenkel, Wallen & Hyun, 2019). After exposure to differentiated instruction tests were used to measure students' academic performance compared performance under traditional instruction. These are evaluating instruments that examine the effectiveness of differentiated instruction in improving learning outcomes. Hothon (2022), proposes pre-test as a first measurement given to learners before training or teaching is done. It is for the assessment of one's ability to execute a concept or a skill. The results of pre-test determine whether students have an idea of the concepts and are they able to research on their own. The researcher gave students a pre-test, marked it and evaluated her learner's ability on interpreting time and finding the angle between the hour hand and minute hand of a clock. Post-test is a task given to studentss after learning to assist in measuring how learners have improved (Rink & Kuller, 2018). A post-test was given to learners in order to compare the results. Results from the pre and post-tests were used to analyse and interpret data collected in making conclusions and recommendations.

3.5.2 Classroom observation

The researcher also employed classroom observation as one of the research instruments. Creswell, (2014) and Tomlinson (2017) state that classroom observation is valuable in capturing practices that teachers may not report in interviews or questionnaires. It offers direct insight into teacher-learner interaction and the actual implementation of differentiated instruction. This method was used to observe how teachers apply differentiated instruction strategies in real time focusing on teaching methods, student engagement and assessment practices. Cooperative learning is one way in which teachers can help students learn to work with one another. It allows students to work in groups to achieve a goal. Teachers can group the students according to abilities or learning styles. The students are then given ample time to work together to complete

a task as the teacher monitors the progress of each group. Research has shown that discussion and questioning between like-minded peers creates a community of learners by supporting each other and, most importantly, helps increase understanding (Johnson, 1999; Scholz, 2004). Cooperative learning groups can also benefit students by reducing competition between peers, allowing students to work at their own pace, and enhancing student or teacher engagement.

3.5.3 Questionnaires

Questionnaires were used as primary instruments for data collection in this study. Structured sets of written questions distributed to mathematics teachers and sometimes students was used to gather quantitative and qualitative data on teachers' perceptions, implementation strategies, and challenges of differentiated instruction. The aim of using questionnaires was to collect starndadised data from teachers and students on the implementation of differentiated instruction in ordinary level mathematics. Questionnaires allowed for gathering views,perceptions and practices rlated to differentiated instruction such as tiered tasks, flexible grouping and student readiness.

3.5.4 Interviews

An interview is a data collection technique that involves verbal communication between the researcher and the respondent, allowing for in-depth exploration of participants' views and experiences (Cohen, Manion & Morrison, 2018). Semi-structured or structured oral questions conducted face-to-face or virtually with teachers and students. This was done to explore deeper insights into experiences, beliefs, and practices related to differentiated instruction. The purpose of the interviews was to gain deeper insights into teachers' and students' perceptions, experiences and challenges in implementing differentiated instruction in mathematics. They provided contextual information and personal experiences that complemented the quantitative data from questionnaires.

3.6 Validity and reliability of differentiated instruction

Differentiated instruction is valid when it aligns with curriculum goals while adapting delivery to suit students. It should support meaningful learning by building on prior knowledge and scaffolding student growth. Differentiated instruction must genuinely reflect understanding of individual needs and not just provide varied activities. Both teachers and students perceive differentiated instruction as a logical and effective approach to inclusive teaching. The strategy appeared purposeful when students saw tasks matching with their ability and progress.

Differentiated instruction yields consistent improvements in student engagement and outcomes when implemented properly. Using differentiated assessment tools like projects, visual tasks, oral responses must still generate reliable data that reflects actual student understanding. A well-structured differentiated instruction lesson in geometry with low, medium and high achieving students show progress over multiple as well as instructional reliability.

Therefore, differentiated instruction is valid and reliable when:

It aligns with curriculum outcomes

It is grounded in sound pedagogical principles

It is implemented consistently with proper teacher training,

3.7 Ethical considerations

According to Chikoko and Mhloyi (1995), ethics has to do with respect for human rights. It involves considerations such as fairness, honesty, respect for the integrity and dignity of the individual and confidentiality of certain information was maintained throughout the process. Respondents were informed of their right to withdraw at any point. Ethical considerations and practices are therefore concerned with the personal behaviour of the researcher. Participants remained anonymous and a code was used for all students from L1F-L50F to represent female students and L1M-L50M to represent male students for the sake of privacy. No participant whether teachers or learners were forced to be part of the investigation and they were informed the purpose of the study.

3. 7 Summary

This study outlined the methodology used to investigate how differentiated instruction was applied in ordinary level mathematics classroom. It described the research design, target population, sampling procedures and the data collection instrument used. The next chapter will focus on data presentation, interpretation and analysis.

CHAPTER FOUR

DATA PRESENTATION, ANALYSIS AND INTERPRETATION

4.0 Introduction

This chapter presents the findings of the study based on the data collected through questionnaires, interviews and observations. The results were organized according to the research objectives and questions using tables, charts and narrative descriptions to enhance understanding.

4.1 Data Presentation, Analysis and Interpretation

Question 1

What is the impact of differentiated instruction in mathematics at ordinary level?

Data gathered from questionnaires, interviews and participant observation indicated that differentiated instruction has a noble positive impact on teaching and learning in mathematics particularly when effectively implemented. Throughout this project I, Teacher Researcher B, feel I have learned a great deal in regards to what my students enjoy about mathematics. Prior to implementing this research project in my classroom, I would feel guilty if an administrator walked into my room and I was not formally teaching my students. I now know it does not take a worksheet to validate that I am teaching a concept to my students. I discovered that even though a game is being played, learning is taking place It does not matter what topic the game is about or who they are paired up with, they love it. Researcher D, have always been challenged with meeting the specific needs of every student in the classroom. It was not until I implemented this project, that I truly saw some light at the end of the tunnel. From the beginning, the literature

gave me encouragement. I was relieved to see other people out there that were struggling with the same problem. It was also reassuring that there were many solutions that I could implement in my classroom. Suddenly, differentiating instruction became a little bump in the road as opposed to a mountain. There were several encouraging things that I observed while implementing differentiated instruction in my math class. The first thing that stood out was that the students were excited when it was time for mathematics. I saw my unmotivated students become motivated.

Question 2

4.1 What strategies do teachers use to differentiate instruction in mathematics?

Figure 1

Flexible grouping seems to be a default approach among teachers because it requires fewer changes to existing teaching routines. Teachers noted that grouping students by ability or readiness helped improve engagement. Tiered instruction helped cater for diverse ability levels within a class, allowing students to work on the same concept at different levels of difficulty. This shows a preference for low-cost, easily manageable differentiated instruction strategies. The lower usage of learning contracts might be due to lack of training or perceived complexity.

Flexible grouping

This is an instructional strategy where students are grouped and regrouped based on their learning needs, readiness, interests or learning profiles. The groups can change depending on the task, topic or assessment results. Students can be grouped based on their understanding of a concept. Some students may understand in visual groups while some in hands-on groups are formed based on topics that appeal to students within the curriculum scope. Sometimes grouping is done to allow peer teaching and social interaction.

Promotes peer learning and collaboration

Allow targeted instruction for specific needs

Prevents students from labelling

Keeps the classroom dynamic and responsive. On the other hand

Requires good classroom management

Needs careful planning and observation

Tiered instruction

This refers to a teaching strategy where teachers design multiple levels of tasks based on students' readiness, interest or learning profiles while keeping the core content the same for all students. Tiered instruction helps students to work on the same key concept but at different levels of complexity and allowing challenge to each student.

It ensures inclusion of all students

Supports growth from current skill level

Promotes deep understanding for advanced students without overwhelming others.

Manipulatives

These are physical objects or tools used to help students visualize and interact with abstract mathematical concepts. Manipulatives support varied learning styles particularly for visual students, kinesthetic students and lower-ability students. They bridge the gap between concrete experience and abstract reasoning and making mathematics accessible.

It improves conceptual understanding

Increase student engagement and motivation

Promotes active participation

Question 3

What are the student perceptions over differentiated instruction?

Table 2

Theme	Sub-codes	Frequency
General opinion	Individual differences considered	21
	Democratic education offered	5
	Collaborative learning	8
	Communication increases	3
	Performance increase	8
	Subject mastery	9
	Efficient lessons	7
	Interested and motivated	13
Differences from current teaching	Activities and materials used	9
	Participation increases	5
Applicability	Applicable	3

Encountered problems	In creating groups	1
	In distributing tasks	2
	Crowded and noisy environment	5

The students' responses about differentiated instruction are presented under four main themes in Table 2: general view, different aspects from the current teaching method, applicability, and encountered problems. In the first theme the students' general views were gathered under three codes: learning environment, cognitive dimension, and affective dimension. Regarding the learning environment code, almost half of the students stated that individual differences were taken into account and that students took an active role. Again, under the same code, five of the students stated that a democratic environment was provided, eight of them stated that a collaborative learning environment was provided, and three student stated that the communication between students had improved. In the cognitive dimension code, the majority of learners stated that the differentiated instruction had increased their achievements and that they understood the subject in greater depth, and seven other students stated that the course was efficient. In the affective dimension code, ten of the students stated that their interest had increased and one of them indicated that their motivation had increased. For example, F3 said the following: "… *everyone studied with their group in the classroom … I was never bored*." When the views of the students on the different aspects of the differentiated instruction as opposed to the current teaching methods were examined, the differences were grouped under three main codes: teacher, learning and teaching process, and students. In the teacher code, one third of the students stated that the number of activities and materials had increased and one student stated that the counselling activities had increased. In the student code, five of the students stated that the active participation in the course had increased and three of them indicated that the course was interesting. For example, student M2 stated that "*we understand the subject very well when the teacher explains it easily*." When the students were asked if the differentiated instruction could be applied to subjects other than mathematics, one third of the students stated that it could always be applied, and other students stated that it could sometimes be applied depending on the subject and the duration of the course. Student M1 stated that "… *it is time consuming but I*

think it can also be applied to other subjects that we do not understand." When the students were asked about the problems they had encountered during the implementation of the differentiated instruction, the students stated that they encountered problems in the distribution of tasks during the creation of groups and during the group study process. In this context, Learner M5 stated that *"... everyone in the group wants to be head of the group…. We also have some friends who do not want to perform their duties in the group…."*

Question 4

What are the challenges faced when using differentiated instruction?

Table 3

Challenge	Percentage
Large class size	80%
Time constraints	90%
Lack of training	70%

These challenges reveal a structural problem that goes beyond the individual teacher's ability. Even when teachers understand differentiated instruction, systematic issues prevent full implementation. Curriculum flexibility, manageable class sizes and adequate resources are preconditions for effective differentiated instruction. Time constrains and large class sizes are the most common challenges, suggesting structural barriers to effective differentiation.

Table 4

Range %	Number of students
0 - 29	5
30 - 39	10
40 - 49	12
50 - 59	15
60 - 69	18
70 - 79	20
80 - 89	12
90 - 100	8

Figure 2

Interpretation

20% of students performed at a high level showing mastery of content. These students likely benefited from enrichment, extension tasks or independent learning challenges. 38% showed solid understanding of concepts but may need targeted instruction to reach mastery. This group

benefited from guided practice, collaborative tasks and strategic questioning. The results indicates that the majority benefited from balanced instruction not overly simplified but not overly advanced. 27% demonstrated partial understanding. These need scaffolding, more structured activities and revision to reach proficiency. 15% are at risk of falling behind. They require use of manipulatives and highly structured instruction. These two groups show that the class require differentiated assessment and perhaps flexible grouping. Therefore, the results show a broad range of abilities within the class.

4.2 Questionnaires

Questionnaires were administered to five teachers and one hundred students across selected secondary schools. 79% indicated they were familiar with differentiated instruction and 21% had limited or have no understanding. Most teachers were aware of the concept though a few may need professional development. While awareness is high, consistent implementation is lacking likely due to contextual challenges.

4.3 Interviews

Teachers have a basic conceptual understanding though some confuse differentiation with remedial teaching, indicating a need for training. Interviews revealed that class size, time constraints and insufficient training ruin the consistence of differentiation. Teachers are open to improving their practice if given appropriate support and professional development. During the intervention, I differentiated just two classrooms of lower level students and the difference between the two classes when I tried to do particular differentiated lessons was enormous. One class could not handle the computer lab because of maturity issues while the other class preferred to learn through lecture and wanted me to tell them the relationships with given quadrilaterals. Sometimes it depended on the day of the week, not just the class. For instance, on a Monday when the students are quiet and focused, I would rather do a lecture. On a Friday when the students are rambunctious, I would love to do a multiple intelligence based discovery activity. Implementing this intervention has given me more practice evaluating different classrooms as

well as individual student needs and strengths. Being flexible is something that I have always counted as a strength of mine and I believe that this challenging project made me get out of my comfort zone and challenged me to experience another method of delivering content to my students.

4.4 Participant observation

Observation and teacher reports indicate that students become more engaged when tasks are adjusted to their ability levels. Post-test also showed improved results in classes where tiered assignments were used. Students respond positively when learning is personalized. This supports the idea that differentiated instruction is not just a teacher convenience but a student-centered strategy that enhances achievement. This aligns with Vygotsky's zone of proximal development where learning is most effective when it is slightly above the student's current ability and guided appropriately. It also boosts learning outcomes particularly among students with low level of readiness.

4.5 Summary

This chapter presented, analysed and interpreted the data collected from mathematics teachers and students. The focus was to examine the extent to which differentiated instruction is being implemented in in the teaching of mathematics at ordinary level, strategies used, challenges faced and the perceived impact of differentiated instruction on student outcomes.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.0 Introduction

This chapter provides a comprehensive summary of the research, restates major findings, draws conclusions, and presents practical recommendations based on the study titled an assessment on

differentiated Instruction in mathematics at ordinary level. The study aimed to examine the extent to which differentiated instruction is applied in teaching mathematics, the challenges faced, and the perceptions of both teachers and students.

5.1 Summary

The study investigated differentiated instruction in ordinary level mathematics in selected secondary schools in Makoni. This research project explored how differentiated instruction is implemented in the teaching of mathematics at the Ordinary Level in Zimbabwe. The study aimed to assess the strategies used by teachers, student engagement, challenges faced, and the overall effectiveness of differentiated instruction in improving learning outcomes.

5.2 Conclusion:

The study concluded that while differentiated instruction has the potential to improve mathematics outcomes, systemic barriers hinder its full implementation. Teacher development, curriculum review, and resource provision are necessary to support wider adoption. The objectives of the study was:

To assess the extent to which differentiated instruction strategies are used in mathematics classrooms.

- To evaluate the perceptions of teachers and students on differentiated instruction.

- To identify challenges teachers face in implementing differentiated instruction.

- To examine the impact of differentiated instruction on student engagement and academic performance.

Using questionnaires, interviews, classroom observations, and document analysis, data were gathered from mathematics teachers and students. The study revealed that while has a positive impact on learner participation and performance, its implementation remains limited.

5.3 Recommendations

The research recommends:

Strengthening the teacher professional development

Schools should be supplied with manipulatives, visual aids, activity cards, and digital content that support varied learning needs.

Reduce class sizes or support differentiation

Allow students to occasionally work on tasks that reflect their interests to improve motivation and engagement.

These recommendations aim to improve the equity, inclusiveness, and effectiveness of mathematics education at the ordinary level through practical, scalable differentiated instruction strategies.

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Questionnaires for teachers

1. Are familiar with the concept of differentiated instruction?

2. What aspects do you consider when differentiating instruction?

3. What challenges do you face in implementing differentiated instruction?

4. What support do you think is needed to enhance differentiated instruction in mathematics?

Questionnaires for students:

1. How do you prefer learning mathematics?

2. Do group activities help you to understand mathematics better?

3. What can your teacher do to help you learn mathematics?

Interview questions for teachers:

1. What informs your decision to differentiate instruction in your mathematics lessons?

2. How do you accommodate students with different abilities?

3. How do students respond to differentiated instruction?

Interview questions for students:

1. What do you think about differentiated instruction approach?

2. Are you comfortable with differentiated instruction during learning?

3. Do you think differentiated instruction should be applied in learning mathematics?