BINDURA UNIVERSITY OF SCIENCE EDUCATION

FACULTY OF SCIENCE EDUCATION

AN INVESTIGATION ON HOW LEARNERS PERFORM IN THE TEACHING AND LEARNING OF DIRECTED NUMBERS AT ZIMBABWE JUNIOR CERTIFICATE FORM TWO AT A SECONDARY SCHOOL IN CHIKOMBA DISTRICT.

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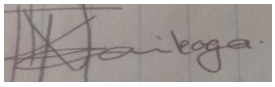
Date 

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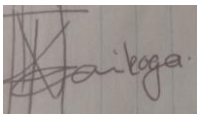
Karikoga Tariro Nancy. 

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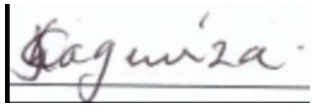
Dr Chagwiza 

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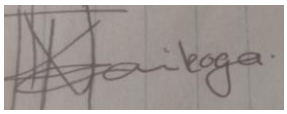
DECLARATION

I, KARIKOGA TARIRO. N, declare that this research project is my original work and has not been submitted to any other institution for the award of any degree or diploma. All sources of information used have been duly acknowledged.

Signature:  _____

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DEDICATION

I would like to dedicate this study to my lovely husband Yeukai Peace Pfereka and my mother who encouraged me through all circumstances to reach this far. To my son Unathi Seth Pfereka and my little sister Takudzwa you are the reason I have so much courage to move on when the road gets tough. To my dear friends and colleagues, I am thankful for all the encouragement you have given me.

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ABSTRACT

This study investigated how learners perform in the teaching and learning of directed numbers at a secondary school in Chikomba District. The research was motivated by persistent poor performance in mathematics among learners, particularly in operations involving directed numbers. A mixed-methods research design was employed, combining quantitative and qualitative approaches. Data were collected using achievement tests, questionnaires, classroom observations, and interviews with teachers. A purposive sample of ten Form Two learners and two mathematics teachers participated in the study.

The findings revealed that most learners exhibited difficulties with addition and subtraction of directed numbers, especially when negative signs were involved. Questionnaire responses indicated that learners lacked confidence in solving directed number problems and often relied on rote methods rather than conceptual understanding. Classroom observations further showed that teachers mainly used the lecture method, with limited use of learner-centered strategies. However, after targeted interventions and practice tests, learners showed noticeable improvement in their performance.

The study concludes that poor performance in directed numbers stems from conceptual misconceptions, limited use of teaching aids, and overreliance on teacher-centered methods. It recommends the adoption of interactive teaching approaches, use of visual aids such as number lines, and continuous assessment to monitor learner progress. The study contributes to improving the teaching and learning of mathematics at secondary school level and provides practical recommendations for enhancing learner performance in directed numbers.

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CHAPTER 1 CHAPTER ONE

1.1 INTRODUCTION

This chapter looks at the background of the study, statement of the problem, research questions, and the importance of the study, sub-problems, delimitations, limitations and the definition of the key terms.

1.2 BACKGROUND OF THE STUDY

Directed numbers, also known as integers, are a fundamental concept in mathematics that underpin later topics such as algebra, functions, and quantitative reasoning across science and technology. However, research has consistently shown that learners struggle with interpreting negative values, distinguishing the meaning of the minus sign, and applying operations with signed numbers (Vlassis, 2004; Bofferding, 2014). Piaget (1952) explained these difficulties as part of the cognitive development process, noting that the idea of numbers "less than zero" requires learners to reconstruct their logical structures beyond whole-number thinking. Similarly, Vygotsky (1978) emphasized that guided interaction within the zone of proximal development is essential for supporting learners as they transition from concrete to abstract mathematical concepts.

International curriculum standards have long emphasized the importance of explicitly teaching directed numbers. For instance, the National Council of Teachers of Mathematics (NCTM, 2000) recommended using the number line to help learners visualize integers, while the National Research Council (2001) stressed the integration of conceptual understanding with procedural fluency. Despite such recommendations, studies continue to report persistent misconceptions, such as learners believing that -5 is greater than -3 or treating the sign as separate from the number (Lamon, 2012; Peled, 2021).Empirical evidence shows that these misconceptions directly affect learners' performance. For example, students often revert to whole-number strategies when working with signed numbers, leading to consistent errors in addition and subtraction (Bofferding, 2010). Recent studies advocate for the use of concrete and visual models, such as counters and number lines, to improve understanding before introducing abstract rules (Peled, 2021). International performance assessments, such as the Trends in International Mathematics and Science Study (TIMSS), have also highlighted weaknesses in learners' number and algebra skills, which are linked to poor mastery of directed numbers (Mullis et al., 2020).In Zimbabwe, the Curriculum Framework for Primary and Secondary Education 2015–2022 emphasized the use of learner-centred pedagogies to

strengthen numeracy foundations (Ministry of Primary and Secondary Education [MoPSE], 2015). The current Curriculum Framework 2024–2030 further builds on this vision, stressing competency-based learning and the need to enhance STEM readiness (MoPSE, 2023). However, research indicates gaps in classroom implementation. For example, Chagwiza and Mashingaidze (2022) found that many teachers struggle to fully adopt learner-centred methods, which limits effective teaching of abstract concepts such as directed numbers.

Local studies in Zimbabwe have shown that directed numbers continue to pose challenges for secondary learners. An action research study found that Form Two learners consistently made errors when subtracting integers, and performance improved significantly when teaching followed a concrete–representational–abstract sequence (Mavhunga, 2019). Similarly, ZIMSEC examiners' reports have highlighted that topics involving integers account for a considerable portion of errors in national examinations (ZIMSEC, 2021).Given these challenges, it is important to investigate how learners in Chikomba District perform in the teaching and learning of directed numbers. Such a study will not only highlight the misconceptions learners hold but also provide insights into effective instructional strategies. This is especially critical in light of the 2024–2030 Curriculum Framework, which emphasizes mastery of foundational numeracy skills for future STEM pathways.

1.3 STATEMENT OF THE PROBLEM

Mathematics is a pillar of scientific and technological knowledge that is of paramount importance in the economic development of any nation. In as much as development of the nation is concerned everyone should participate. For this reason, Mathematics has been made a compulsory subject for all learners up to Ordinary Level in Zimbabwe. While it is an obvious requirement to allow all learners to achieve at full potential of all topics in Mathematics, it also enables credit for work and levels of achievement to be awarded. All prescribed work must be completed to a satisfactory standard and assessment responses must be deemed a genuine response to the set criteria for the task.

However, it has been observed by the researcher that some learners are being outsmart by other learners in as far as the learning of directed numbers in Mathematics is concerned. Majority of the learners showed difficulties in the understanding of the directed numbers concepts taught. Majority of the learners performed bad in directed numbers exercises and tests, less scoring higher and pleasing marks.

Given the above concerns and observations made by the researcher, it was really necessary that the researcher investigates the performance of learners in directed numbers. The study may have been carried out in some parts of the world but the results found cannot be generalised to a Secondary school in Chikomba District, which is why the researcher sought to explore the performance of learners in directed numbers specifically to Form 2 learners at a school in Chikomba District.

1.4 RESEARCH QUESTIONS

The research work will be done so as to come up with clear arguments based on the following questions:

1. What are the causes of poor performance by Form 2 learners in the teaching and learning of directed numbers at school in Chikomba District?
2. Which possible measures can be adopted to improve the performance of learners in the learning of directed at a school in Chikomba District?
3. Are there challenges faced when trying to improve performances by learners in the learning of directed numbers?

1.5 Assumptions of the Study

This study is guided by several assumptions that are believed to hold true in the context of teaching and learning of directed numbers at Form Two level. Firstly, it is assumed that both learners and teachers have had prior exposure to basic number concepts from earlier grades, which provide a foundation for the study of directed numbers. Secondly, the study assumes that learners' performance in directed numbers is influenced by the teaching strategies employed, including the use of teaching aids, learner-centered approaches, and classroom interaction.

It is further assumed that the learners who will participate in this study will respond honestly and accurately to questionnaires and test items administered. The study also assumes that the school environment, including availability of resources such as textbooks and chalkboards, remains relatively constant throughout the research period. Moreover, it is assumed that external factors such as learners' background knowledge, motivation, and attitude towards mathematics play a role in their performance but are not strong enough to compromise the focus of this study.

Finally, it is assumed that the sample selected for the study is representative of the broader Form Two learner population in similar rural secondary schools, thereby making the findings generalizable to a larger context.

1.6 SIGNIFICANCE OF THE STUDY

The study is significant to various stakeholders, including the researcher, teachers, the learners as well as the school administrators. The research will explore the factors limiting learner participation and performance in directed numbers as well suggesting ways to improve their performance. This will enlighten educational stakeholders to improve their approaches in dealing with learners in the teaching and learning of Form 2 directed numbers and to equip them with the knowledge on the research topic. The findings of the study may provide insight to school administrators towards designing sound policy framework that can be used in guiding improving performance in directed numbers by learners. The study is bound to help learners in gaining control of their weaknesses in as far as the study of directed numbers is concerned. Owing to the existing gap in the studies on the performance of learners in directed numbers, this study is also expected to add to the growing body of knowledge regarding this topic in question.

1.7 DELIMITATIONS OF THE STUDY

The study was confined to a certain Secondary School in Chikomba District in Mashonaland East Province in Zimbabwe. The study focused on the performance of learners in directed numbers. It also looked on the causes of poor performance by learners in the study of directed numbers, the possible solutions to curb the poor performance in directed numbers by learners as well as looking into the possible challenges faced in trying to curb this problem. Participants were learners from two Form 2 classes and some teachers at the same school as well.

1.8 LIMITATIONS OF THE STUDY

Time management was one limitation. Since the researcher was on teaching practice at the school in question and had to make sure that she attended to all the lessons on her schedule. The school was busy with its normal programmes during data collection. However, the researcher had to make appointments in advance and had to arrive early for interviews and sometimes had to make use of the lunch time to conduct interviews. Additionally, two days of the week were scheduled for sporting activities and learners and teachers would walk straight to the playing fields soon after the lessons. This made it difficult to assemble the focus groups

as some group participants would be participating in different sporting disciplines. Nonetheless, to counter this problem, the researcher had to make appointments so that convenient time for the groups of participants was chosen. The researcher again had to thirty minutes before the appointment time so that the focus group interviews started and ended on time without rushing through the interview questions.

Furthermore, some of the participants were not comfortable with voice recording, but this was solved when the researcher explained the purpose of the study and assured the participants that the research was only for educational purposes. Once more, the issue of confidentiality was emphasised by the researcher. After all the assurance from the researcher, the participants felt at ease to respond to the interview questions.

1.9 DEFINITION OF KEY TERMS

DIRECTED NUMBERS

Ashcraft (2021) defines directed numbers as numbers with both size and direction,one direction is positive and the other is negative. According to Philip(2023), Directed numbers are integers which have a particular size or magnitude and a direction. From the above definitions Directed numbers are numbers which have a direction and size. One direction is given as positive and the other negative for example temperatures above and below freezing.

PERFORMANCE

According to the English dictionary performance is the act of carrying into execution or action, accomplishment, representation by action.

1.10 SUMMARY

This chapter looked at the background of the study, statement of the problem, research questions, significance of the study, delimitations of the study, limitations of the study and definition of key terms. The subsequent chapter discusses theoretical frameworks that informed the study and reviews literature in line with the research questions.

CHAPTER 2 LITERATURE REVIEW

2.1 INTRODUCTION

The previous chapter focused on the background of the study, statement of the problem, research questions, significance of the study, delimitations of the study, limitations of the study, and definition of key terms. This chapter now sets to review related literature. The literature facilitated the researcher to have an insight into what other researchers have written on the causes and possible solutions the performance of form 2 learners in Directed numbers as well as challenges faced in trying to implement the possible solutions. The related literature is reviewed under the following sub-headings; how form 2 learners perform in directed numbers , possible solutions to the challenges faced by learners during solving directed numbers and challenges faced in trying to curb the poor performance in directed numbers by learners. Findings of what others have discovered on the topic will be presented. Gaps in previous researches will also be highlighted. This chapter will end by a summary of the main points discussed.

2.2 CAUSES OF DIFFERENT PERFORMANCE IN DIRECTED NUMBERS

2.2.1 Encouragement from adults including cultural beliefs

Beliefs might be thought of as lenses which one looks when interpreting the world (Philipp, 2023). Research shows that beliefs and feelings adults experienced as learners carry forward to their adult lives and their feelings are important factors in the way they relate to the new generation. Mcleod (2012) firmly asserts that most learners, hold the belief that being good in Mathematics is mainly due to ability than effort. Mandina (2013) points out that learner participation in Mathematics is largely hinged on the encouragement learners get from their parents and teachers. He recommended that teachers and parents should de-emphasize gender and cultural beliefs attached to Mathematics. This study also intends to find out if encouragement from parents and teachers at a Damba Secondary school in Chikomba District have affected the performance of learners in Form 2 in directed numbers. Dweck (2020) highlights that, environments and households that are heavily influenced by beliefs that most learners may be disadvantaged genetically when it comes to Math ability can have serious negative effects on Mathematics interest which causes them to perform differently in solving directed numbers.

Dweck and Legget (2021) further argue that parents play an integral role in shaping how learners view Mathematics ability and related performance. If parents believe that Mathematics ability is genetic and success affects predisposition, learners who receive such messages, when encounter difficulties will then see these as proof that they lack natural Mathematics ability. In addition, pervasive social, cultural and historical messages that Mathematics is not useful to all learners. These messages although unfolded scientifically start with influential adults such as parents and teachers. Teachers are not immune to holding stereotypes about learners in the study of directed numbers in Mathematics.

2.2.2 Directed numbers anxiety

Many definitions of Mathematics anxiety exist, Mcleod (2022) define Mathematics anxiety as feelings of tension and anxiety that interfere with the manipulation of numbers and the solving of Mathematical problems in a wide variety of ordinary life and academic situations. Generally Mathematics anxiety is an intense emotional feeling of fear and frustration that learners have about their ability to understand and do Mathematics. One of the consequences of Mathematics anxiety as postulated by Hembree (2020) includes the avoidance of taking Mathematics courses. Ashcraft (2022) and Hembree (2020) both argue that more girls report higher Mathematics anxiety than boys which causes the difference in the performance on Directed Numbers. Mandina and colleagues (2013) in their study highlighted that, since Mathematics is traditionally viewed as a male domain, girls may be socialised to think of themselves as mathematically incompetent. This may lead to that action of girls avoiding solving directed numbers problems and when they do participate in mathematical activities, they may experience more anxiety than boys .

2.2.3 Self-confidence

Self-confidence has to do with how sure a learner is about his abilities. Bandura (2006) posits that self-confidence refers to firmness or strength of belief that one can successfully execute a specific activity. In addition, Bandura (2006) asserts that, in a responsive environment that rewards performance achievements, the outcome people expect depend heavily on their self-confidence that they can perform a skill. Jewett (2021) also argues that gender-based participation in Mathematics can be explained by teacher-pupil interactions in the classroom and the lack of self-confidence some have in their Mathematics skills. Gudyanga and Mandizvidza (2016) asserts that self-confidence in girls is less than that of their boy counterparts. In their findings they argued that, if some learnes believe that they will not

achieve in Mathematics, then automatically they may not achieve simply because they may not invest enough energy in solving problems of directed numbers. In their study Gudyanga and Mandizvidza (2016) further show that, some learners did not have confidence in their Mathematics ability simply because they were constantly told that they were not as intelligent as other learners to study Mathematics which causes the difference in the performance of directed numbers.

2.2.4 Conceptual Misconceptions

Learning directed numbers has historically presented difficulties to learners worldwide, and these challenges often arise from deep-seated conceptual misconceptions. Misconceptions are not simply errors but rather systematic misunderstandings that learners bring into the classroom. According to Smith, diSessa, and Roschelle (1994), misconceptions are robust alternative frameworks that learners construct based on prior knowledge. When teaching and learning directed numbers, these misconceptions often interfere with the acquisition of new mathematical concepts.

One common misconception among learners is the belief that negative numbers "do not exist" or are "smaller" in the sense of being less real than positive numbers (Gallardo, 2002). Piaget (1952) explained this as a developmental difficulty, since the concept of "numbers below zero" requires a shift from concrete whole-number experiences to abstract reasoning. In the Chikomba District, Form Two learners frequently demonstrate this by ignoring the negative sign or treating it as insignificant when solving problems in class (Mavhunga, 2019).

Another well-documented misconception relates to the minus sign. Vlassis (2004) categorized its multiple meanings: as an operator for subtraction, as an indicator of a negative number, and as a symbol in algebraic expressions. Learners often conflate these meanings, leading to errors such as interpreting "−3" as "take away 3" rather than "a value three units below zero." This misunderstanding causes persistent errors in addition and subtraction of integers (Bofferding, 2010). For example, learners may incorrectly calculate $-7 + 5$ as -12, a mistake noted both in international contexts and in local Zimbabwean classrooms (ZIMSEC, 2021).

Learners also struggle with ordering negative numbers. A frequent misconception is the assumption that a larger digit implies a larger number, even when signs are involved (Lamon, 2012). For instance, many learners believe that -8 is greater than -3 because eight is larger than three. Such misconceptions show that learners tend to apply whole-number reasoning to directed numbers without considering the role of the negative sign (Peled, 2021). Observations

in Chikomba District confirm that Form Two learners often misplace integers when asked to arrange them on a number line (Mavhunga, 2019).

Overgeneralization is another conceptual difficulty where learners apply familiar rules from whole numbers to integers. For example, the rule that "a larger number minus a smaller number is always positive" is mistakenly extended to directed numbers, resulting in errors when solving problems such as $3 - 5$ (Gallardo, 2002). This overgeneralization reflects a lack of conceptual understanding of the integer system and points to inadequate scaffolding during instruction.

These misconceptions suggest that traditional rule-based teaching approaches, where learners memorize procedures without conceptual grounding, are insufficient (Bofferding, 2014). Vygotsky's (1978) socio-cultural theory emphasizes the need for guided instruction within the learner's zone of proximal development, which can help address misconceptions through scaffolding, peer learning, and contextualized teaching. In Zimbabwe, the Curriculum Framework for 2024–2030 stresses competency-based and learner-centred teaching methods, offering an opportunity to address these challenges more effectively (MoPSE, 2023). However, as Chagwiza and Mashingaidze (2022) observe, many teachers in secondary schools—including those in Chikomba District—still face challenges in implementing learner-centred pedagogy, which may contribute to the persistence of misconceptions.

2.2.5 Procedural and Strategic Errors

Learners often commit procedural errors such as dropping the negative sign or misapplying rules (e.g., assuming "$-3 \times -2 = -6$"). A common error known as Detachment from the Minus Sign (DFMS) occurs when learners ignore or detach the negative sign in algebraic or arithmetic expressions (Prediger et al., 2022). These errors persist because learners memorize rules (like "negative × negative = positive") without understanding the reasoning behind them. As a result, learners' performance differs depending on whether they rely on memorized rules or on conceptual grasp.

2.2.6 Cognitive and Affective Factors

Learners' cognitive abilities play a role in their performance. Those with dyscalculia or weak number sense find it particularly hard to visualize negative numbers on a number line or understand operations with negatives (Butterworth, 2010). Working memory overload, poor attention, and perceptual difficulties also hinder mastery (Dowker, 2009). On the affective side, mathematics anxiety is a major contributor. Anxiety consumes working memory resources,

reducing performance in tasks involving directed numbers (Ashcraft & Krause, 2007). This explains why learners with high math anxiety often underperform compared to their confident peers.

Cognitive factors refer to the mental processes involved in acquiring knowledge, such as memory, reasoning, and problem-solving. According to Piaget (1952), the cognitive development stage of learners determines their readiness to handle abstract concepts like negative numbers. Many Form Two learners in Chikomba District are transitioning from concrete operational to formal operational stages, which means that they may still rely heavily on tangible representations before fully grasping abstract rules.

Working memory and prior knowledge also play a significant role. Ashcraft and Krause (2007) note that learners with limited working memory capacity often struggle with multi-step problems, such as those involving operations with directed numbers. Similarly, misconceptions rooted in prior whole-number knowledge interfere with the assimilation of new integer concepts (Bofferding, 2010). Without targeted instructional scaffolding, learners tend to fall back on overgeneralized rules, reinforcing their errors.

Cognitive flexibility is another important factor. Learners who can switch between number line representations, concrete models, and symbolic notation are more successful in understanding directed numbers (Peled, 2021). However, in contexts like Chikomba District where learners have limited exposure to manipulatives and visual aids, many rely solely on rote procedures, which undermines deeper conceptual understanding (Mavhunga, 2019).

Affective factors include attitudes, emotions, beliefs, and motivation toward mathematics. Research shows that learners' beliefs about mathematics significantly affect their performance. Negative attitudes toward mathematics can reduce engagement and persistence, leading to poor outcomes in challenging topics such as directed numbers (Hannula, 2006). In Zimbabwe, ZIMSEC (2021) reported that low motivation and exam anxiety contributed to common errors in problem-solving, including operations with integers.Mathematics anxiety is a critical affective barrier. Ashcraft and Ridley (2005) argued that anxiety consumes working memory resources, leaving fewer cognitive resources available for solving mathematical tasks. For Form Two learners, this manifests in avoidance of challenging exercises involving negative numbers, reliance on guesswork, and a tendency to give up easily when encountering difficulties.

Learners' self-efficacy—the belief in their ability to succeed in mathematics—also influences performance. Bandura (1997) emphasized that students with higher self-efficacy approach difficult problems with greater persistence, while those with low confidence avoid or disengage. In Chikomba District, classroom observations have shown that learners who perceive themselves as "weak in mathematics" are less willing to attempt integer problems, which perpetuates their misconceptions and low achievement (Chagwiza & Mashingaidze, 2022).

Cultural and contextual factors further shape affective experiences. In many Zimbabwean classrooms, teacher-centred methods dominate, and learners may feel intimidated to express their thinking openly (Chagwiza & Mashingaidze, 2022). This lack of a supportive environment reduces opportunities for learners to confront and correct their misconceptions about directed numbers.

2.2.7 Teacher-Related Factors

Teacher knowledge and pedagogical approaches strongly influence learner outcomes. If teachers lack confidence in teaching negative numbers, they may unintentionally pass misconceptions to learners (Chikiwa & Schäfer, 2016). Over-reliance on traditional chalk-and-talk methods, without manipulatives or contextualized teaching, leads to rote learning. Research in Zimbabwe has highlighted that learners benefit when teachers use number lines, counters, and real-life examples, as these methods make abstract ideas more concrete (Chauraya, 2013). Thus, differences in teaching quality contribute to performance gaps among learners.

2.2.8 Language and Communication Barriers

Mathematical language poses challenges for many learners. Words such as "minus," "less," and "negative" can be confusing when used interchangeably (Schleppegrell, 2007). Learners with limited English proficiency may misinterpret instructions or problem statements, leading to errors (Bhebhe, 2016). This language barrier widens the performance gap, especially between learners in urban schools (where English exposure is higher) and those in rural settings.

2.2.9 Socio-Economic and Environmental Factors

Differences in home and school environments also explain varying performance. Learners from low socio-economic backgrounds may lack exposure to learning resources or parental support in mathematics (Siyepu, 2013). Large class sizes, common in many Zimbabwean schools, make it difficult for teachers to provide individualized support, further disadvantaging weaker

learners. Peer influence also matters, as learners who perceive mathematics as too difficult often develop negative attitudes, reducing effort and persistence (Mutambara & Bhebe, 2019).

2.3 IMPROVING PERFORMANCE OF LEARNERS IN DIRECTED NUMBERS

Several studies around the world, both in developed and developing countries have been conducted to suggest ways of improving the general performance of learners in the teaching and learning of directed numbers at secondary school level. Viewing a sum as a move to an end point from a start point on a number line can help learners grasp directed numbers effectively. In addition all teachers my intimate learners by offering a basis for their belief and attain consolidated ideas ,decent semblance of procedural skill facility in working on directed numbers calculations, across a range of context. Moreover, some learners are often led to believe by influential others as emphasized by Dweck (2020), such as parents or teachers that Mathematics ability is innate, while others are led to believe that Mathematics ability is something that can be developed by hard work. To actively counter the stereotypes that promote learners in Mathematics related domain, educators must adopt some of the recent instructional methods that actively involve learners and stop pedalling philosophies that create phobias in them.

The performance of Form Two learners in directed numbers at Damba Secondary School can be enhanced through the adoption of effective teaching strategies, learner-centered approaches, and supportive school practices. Directed numbers, which include positive and negative integers, often pose difficulties to learners due to abstract concepts such as adding, subtracting, multiplying, and dividing numbers with signs. Research shows that difficulties usually arise from misconceptions about the “rules of signs” and a lack of concrete experiences that link abstract concepts to real-life contexts (Makonye & Fakude, 2014).

One way of improving performance is through the use of teaching aids and concrete materials. Teachers may use number lines, counters, or thermometers to visually demonstrate the movement between positive and negative values. For example, a number line can help learners understand that subtracting a negative number is equivalent to moving forward on the line. Such visualization reduces confusion and enhances conceptual understanding (Ncube, 2019).

Another strategy is the application of learner-centered methods such as group work, problem-based learning, and peer teaching. Learners should be encouraged to solve practical problems involving directed numbers, such as temperatures, bank transactions, or elevations, to make the

content more relevant and meaningful. Contextualizing mathematics increases learner motivation and reduces anxiety (Mutambara & Bhebhe, 2021).

Teachers should also make use of technology and digital resources where possible. Simple mathematics software, mobile applications, or interactive videos can offer engaging simulations that allow learners to manipulate directed numbers in a fun and interactive manner. This aligns with modern approaches to teaching that emphasize blended learning and ICT integration (Chikasha, 2020).

Furthermore, continuous assessment and timely feedback play a vital role in improving performance. Teachers should provide short quizzes, oral questioning, and practice exercises, followed by constructive feedback. This helps to identify misconceptions early and provide corrective measures before they affect overall performance.The attitude of learners toward mathematics also influences their success. Teachers at Damba Secondary School should foster a positive learning environment by praising effort, encouraging persistence, and reducing fear of failure. Parental involvement can further enhance this by ensuring learners receive support with homework and practice at home (Shizha, 2022).

Preis and Biggs (2021) argued that poor teaching can be one possible source of solving directed numbers anxiety. Learners with Mathematics fears need instructors who are patient and encouraging. They need instructors as highlighted by Preis and Biggs (2021), who can help them gain self-confidence in doing Mathematics and who can help them come to believe that they are capable of learning Mathematics.

Tanton (2019) outline the use of robbot steps,a sentry or a robbot follows a clear set of instructions. Associated with a number line,the robbot always starts and return's to a home position at zero. They alw start by facing in the positive direction. A negative sign in between step command tells the robbot to turn and face left. Cards can be put on the wall to remind learners about which direction to face either + or _. Moving commands are put in brackets to identify them as such and involve pacing for example +2 means go forward two steps,_3 means backwards three steps.

2.4 CHALLENGES IN LEARNERS' PERFORMANCE IN DIRECTED NUMBERS

Yes, there are significant challenges that hinder efforts to improve the performance of Form Two learners in the learning of directed numbers at Damba Secondary School in Chikomba

District. These challenges arise from both learner-related and teacher-related factors, as well as school environmental constraints.

2.4.1 Persistent Conceptual Misconceptions

Even when interventions are introduced, learners continue to struggle with the abstract nature of directed numbers. For example, the "rules of signs" (e.g., negative × negative = positive) are often memorized without deep conceptual understanding. This makes it difficult for learners to transfer knowledge to problem-solving contexts, leading to repeated errors (Makonye & Fakude, 2014).

2.4.2 Limited Use of Teaching Aids

While teachers may attempt to use number lines or other visual aids, resource shortages in rural schools often limit consistency in their use. Without sufficient teaching aids, efforts to make abstract concepts more concrete are undermined (Ncube, 2019).

2.4.3 Negative Learner Attitudes and Mathematics Anxiety

Improving performance requires learner motivation and confidence. However, many learners approach mathematics with fear and anxiety due to past failures, which reduces participation and willingness to practice. This persistent negative mindset limits the effectiveness of teaching interventions (Mutambara & Bhebhe, 2021).

2.4.4 Weak Foundational Knowledge

Learners with poor mastery of basic arithmetic operations face difficulties in building new knowledge on directed numbers. Even when teachers introduce remedial measures, weak foundations in addition, subtraction, multiplication, and division make it hard for learners to progress quickly (Shizha, 2022).

2.4.5 Inadequate Teaching Time and Methods

Mathematics lessons are often time-constrained, leaving teachers with little opportunity to provide individualized attention. Some teachers still rely heavily on lecture and rote methods instead of learner-centered approaches. This challenge persists even when strategies for improvement are proposed (Chikasha, 2020).

2.4.6 Resource and Environmental Constraints

Schools such as Damba Secondary face shortages of textbooks, ICT tools, and learning materials. Large class sizes also make it difficult to implement group work or individualized

support. As a result, improvement efforts may not yield the intended outcomes due to structural limitations (Shizha, 2022).

2.4.7 Language Barriers

Because mathematics is taught in English, learners with limited English proficiency may fail to grasp the language of word problems. Even when performance improvement strategies are applied, language challenges remain a barrier to comprehension and success (Mutambara & Bhebhe, 2021).

Beliefs might be thought of as lenses through which one looks when interpreting the world (Philipp, 2022). Research shows that beliefs and feelings adults experienced as learners carry forward to their adult lives and their feelings are important factors in the way they relate to the new generation of learners. Mcleod (2021) firmly asserts that most learners , no matter how much they try to want to improve in Mathematics, they face discouragement from their parents at home. Parents hold the belief or myth that being good in Mathematics is mainly due to ability than effort (Mcleod, 2012). One of the major challenges faced in trying to improve learners' performance in directed numbers is that the learners face discouragement from their parents. Dweck and Leggett (2020) further argue that parents play an integral role in shaping how learners view Math ability and related performance.

Another challenge highlighted is that some might not just want to improve on their Mathematics performance which resulted to the different perfomance of learners in directed numbers due various reasons. Xu (2011) asserts that some learners just become reluctant in trying to improve their performance in directed numbers. Karabag (2015) observes that a larger percentage of the learners develop a negative attitude towards negative numbers than positive number in general as a result of reduced exposure to the solvin of directed numbers as they progress with their course as a result they will become reluctant to improve on their performance.

2.5 SUMMARY

This chapter was on literature review. It centred on what other researchers have written in relation to the study. An analysis has been made on previous findings on the causes and possible solutions to learners performance in directed numbers in form 2 . The following chapter, that is, chapter 3, will be on the research methodology. It will be an outline of how the data was collected and the method of presentation that were used.

CHAPTER 3 CHAPTER THREE METHODOLOGY

3.1 INTRODUCTION

The previous chapter has dealt in detail with literature related to this study. This chapter is taking further from the previous one by putting emphasis on research methodology used in this study, the research design, research instruments and proposals for data presentation, analysis and interpretation procedures. Research tools which were used include observations, interviews, tests (pre-tests and post-tests), questionnaires and document analysis.

3.2 RESEARCH DESIGN

A research design is a plan of how to proceed in determining the nature of the relationship between variables (Bless & Higson-Smith, as cited in Creswell, 2020) views a research design as a plan or strategy which moves from the underlying philosophical assumptions to specifying the selection of respondents, the data gathering techniques to be used and analysis to be done. The research designs include; descriptive survey, experimental, case study or quasi-experimental. This study adopted a case study design which aims to examine research questions and issues, by setting these in a contextual and often causal context. Yin (2022) defines the case study research method as an empirical inquiry that investigates a contemporary phenomenon within its real-life context when the boundaries between phenomenon and context are not clearly evident and in which multiple sources of evidence are used. In this case, the case study design gave the researcher a leeway to obtain views and opinions on how form 2 learners perform on directed numbers at a school in Chikomba District and the possible solutions to remedy if their is poor performances.

The case study, therefore, aided the researcher to use observations, face to face interviews and document analysis in soliciting data from participants pertaining on their performances in Directed numbers by Form 2 learners.

The case study method enabled the researcher to closely examine the possible solutions for remediating poor performances and also how to make those performing to continue doing that in Directed numbers by learners as well as the challenges faced in trying to remedy these poor performances. The approach opened the possibility of giving voice to the voiceless and powerless, like learners. This is essential for the researcher to come to a deeper understanding of the dynamics of the situation.

3.3 DATA COLLECTION INSTRUMENTS

Data collection is an essential component to conducting research (Kajornboon, 2019). Data collection can be derived from a number of instruments, which include interviews, focus group discussion, surveys, observations, field notes, taped social interaction, document analysis tests or questionnaires. Therefore, which data collection instrument to use often depends upon the research objectives and the strengths and weaknesses of each instrument (O'Leary, 2021). The data collection instruments used in this study were face to face interviews, observations and tests.

3.4 POPULATION

Creswell (2021) views the population as that group people which the researcher is interested in gaining information and drawing conclusions. Bannet and Rivers (2021) also define the population as a group of participants being focused on by the study and, in most cases, the groups being studied could be too large for all members to participate. The target population in this case were two classes of Form 2 learners at a Secondary School in Chikomba District, each class was made up of 60 learners to make them a total of 120 and their ages ranging from 13 years to 15 years.

3.5 SAMPLE AND SAMPLING PROCEDURE

A sample is described as a model or make up that represents the whole group. Sampling refers to the process of selecting people or elements from a population for inclusion in a research study (Patton, 2022). Ashcraft (2020) also defines sampling as the process used to select a portion of the population for the study. Therefore, in this study, sampling is a systematic principle based procedure used to make well considered selection that enables a researcher to gain access to relevant data sources.

A well selected sample, therefore, positively contributes to the credibility of the findings in any given research. This is an important aspect of confirming the authenticity of the results especially in a qualitative approach. The sample in this study comprised 10 learners (5 from each of the two classes involved).

There are various sampling procedures for selecting the sample, examples of sampling procedures include; systematic, random and purposive. The current study adopted purposive sampling which is non-probability sampling technique where the researcher identifies

information rich participants for the reason that they are possibly knowledgeable about the phenomena under study. Phillip (2022) suggests that the logic and power of purposeful sampling lies in selecting information rich cases for study in-depth. Information rich cases are those from which one can learn a great deal about issues of central importance to the purpose of the research. Hence, in this study, the researcher targeted known rich information sources which were 10 learners who performed differently in the learning of Mathematics. Purposive sampling, therefore, allowed the researcher to apply some of the sample plans by manipulating activities and analysis interactively during the process.

3.5.1 INTERVIEWS

The interview is one of the techniques used in collection of data in this study. An interview is a two-person conversation which is initiated by the interviewer for the specific purpose. Rhodes and Wilson (2020) interviews are a qualitative method of research often used to obtain the interviewees' perceptions and attitudes to the issues under study. The interview was a semi structured one where the interviewer had worked out a set of questions in advance but was free to modify them during the conversation. Since the interviewer had a general area of interest and concern, in this case was on how learners perform in Directed numbers in Mathematics learning. The interviewer had a roll on and develop conversation in that area. The researcher interviewed 10 learners who were involved in the research at a Secondary in Chikomba District. An interview allows more time to probe further so as to understand the area of concern. It is very easy to notice that some learners respondent did not understand the question being asked and others understood, and the facial expressions can lead to understanding or noticing the unsaid.

Despite the highlighted strengths of using interviews as a data collection instrument, Mcleod (2012) identifies quite a number of weaknesses associated with interviews. The weaknesses include the fact that collected data may contain biased information as a result of poorly phrased questions. Inaccuracy due to poor recall may be another limitation of interviews (Mcleod 2012). That is, some participants may fail to remember exact details but feel inhibited to own up to this weakness. Another demerit of interviews as stated by Creswell (2009) is that some participants might not be articulate and this affects the data provided.

Regardless of the stated limitations, interviews remain a suitable data collection instrument for this study. To counteract bias due to poorly constructed questions, the researcher utilised the input of experienced researchers.

3.5.2 OBSERVATION

Observation is an activity of living being, such as human which is necessary in order to receive knowledge of the world. Schumber and McMillan (2021) agree that observation includes taking cognisance of verbal and non-verbal behaviour and the researcher makes notes. The researcher used observation method as it allowed her to explore the signs and behaviour replicated by learners during lesson delivery which could account for the performance of learners in Directed numbers in Mathematics. Observation enables the researcher to collect data when an activity or lesson is taking place, does not rely on people's willingness or ability to provide information. It also allows the researcher to directly see what people do rather than what people say. However, it can be time consuming compared to other data collection methods.

3.6 DATA PRESENTATION, ANALYSIS, INTERPRETATION AND DISCUSSION OF FINDINGS

Data analysis is the process of systematically searching and arranging interview transcripts, field notes, video or audio recordings, and other materials that are accumulated by the researcher so that he can make findings (Bogdan & Bilken, 2017; Remler & Ryzin, 2021). Analysis of qualitative data is concerned with organising and working with the data, breaking them into manageable units, coding and synthesising them, and searching for patterns (Bogdan & Bilken, 2017). In this study, data were systematically built through recording proceedings during interviews, observations and document analysis. As the researcher conducted interviews, patterns and interpretations occurred to the researcher, and influenced the course of further data collection, it was essential for the researcher to prepare transcripts from audio-taped interviews. Hancock et al. (2020) describe transcribing as the procedure for producing a written version of an interview or conversation. It is a full script of the interview or conversation. Thus, the researcher transcribed data soon after the interviews had been completed, while the researcher still remembered the whole process. During transcription, the researcher played and carefully listened to the recorded interviews and then transcribed the data. The data was also presented thematically through tables to show the numbers of those who responded either positively or negatively to a certain remediation strategy.

3.7 ETHICAL CONSIDERATIONS

Ethics has become a cornerstone for conducting effective and meaningful research. As such, the ethical behaviour of individual researchers is under unprecedented scrutiny (Best & Kahn, 2022; Trimble & Fish, as cited in Drew, Hardman & Hosp, 2020). Hence, it was imperative to consider ethics when the researcher was conducting the study. Research ethics refer to rules of morally good conduct for researchers (Gomm, 2021). Every researcher has a responsibility to protect the participants in an investigation.

The researcher asked permission to get information from the respondents by explaining the purpose of the research. The researcher got permission to carry out the research from the school head. The data collected by the researcher was strictly used for this research only. Subjects' rights were safeguarded throughout the research. In this regard, all the information that was given to the researcher remained confidential. The data collected was not tempered with in any way other than analysing and interpreting it as discussed above. Upholding of individual's rights to confidentiality and privacy was done as individuals signed forms which promised them of their confidentiality being maintained. The information gathered was used for academic purposes only and names of the respondents were not used so as to protect their privacy.

3.7.1 ANONYMITY

The principle of anonymity essentially means that the participant will remain anonymous throughout the study. That is, only the respondent knows that he or she participated in the research and the research cannot disclose identity of the participants. Letters of the alphabet were used to represent names in order to protect the participants' privacy.

3.7.2 CONFIDENTIALITY

Confidentiality can be defined as an explicit or implied guarantee by a researcher to a respondent whereby the respondent is made confident that any information provided to the researcher cannot be attributed back to that respondent. The information obtained from the participants will be kept confidential by the researcher and will only be used for academic or developmental purposes only.

3.7.3 INFORMED CONSENT

The principle of informed consent entails that potential respondent must be given sufficient information to allow them to decide whether or not they want to take part in the research. The

researcher explained everything that was involved in the research and she considered voluntary participation such that only those willing to participate in the research were considered.

3.7.4 FEASIBILITY

The study was feasible since the study area was readily accessible to the researcher. The researcher sought and was guaranteed permission to carry out the study at a certain school in Chikomba District in Sadza by the School Head. Sampling also helped the researcher to deal with a small group which was enough for the resources that were available. And this made the research very practical. All the 10 learners who were involved were willing to participate in the study.

3.8 SUMMARY

The methodology adopted by the study was discussed in this chapter under various subheadings that included the research paradigm that directed the focus of the study. The research paradigm which is qualitative was delineated explaining its features and deficiencies. The research design chosen was the case study which was clarified, justifying it choice and also highlighting its shortcomings. The chapter also discussed the population, sample and sampling procedures followed. The sampling procedures were clearly defined and purposive sampling technique was explained qualifying its choice for the study. Data collection techniques that include face to face interviews, observations and document analysis were discussed. The data analysis and ethical considerations were also discussed in the chapter. The next chapter focuses on data analysis and presentation.

CHAPTER 4 CHAPTER FOUR: DATA PRESENTATION AND ANALYSIS

4.1 INTRODUCTION

This chapter presents and analyzes data collected from interviews , observation and tests with 10 Form Two learners at a Secondary School in Chikomba District.The focus was on their perceptions of whether they believe they can improve in directed numbers if given more practice and support.

4.2 Learners' Views on Improvement in Directed Numbers

Learners were asked the question: "Do you believe you can improve in directed numbers if given more practice and support?"

The responses are presented in Table 4.1.

Table 1: Learners' Views on Improvement in Directed Numbers (N = 10)

RESPONSE OPTION	NUMBER OF LEARNERS	PERCENTAGE (%)
Yes	7	70%
No	2	20%
Not sure	1	10%
Total	10	100%

4.3 Interpretation of Results

The results in Table 4.1 show that the majority of learners (70%) believe they can improve in directed numbers if given more practice and support. This suggests that learners recognize the importance of practice, teacher assistance, and resources in enhancing their performance.

However, 20% of learners expressed doubt, indicating that some may lack confidence in their ability to improve, possibly due to persistent misconceptions or negative experiences with

mathematics. One learner (10%) was undecided, which shows uncertainty about whether external support would make a significant difference.

These findings highlight that most learners are motivated to improve, provided they receive adequate guidance and practice opportunities. Nevertheless, there is still a need for targeted interventions to address the negative attitudes and lack of confidence observed in a minority of learners.

4.4 Learners' Views on Practice Time for Directed Numbers

Learners were asked whether they get enough time to practice directed numbers both in class and at home. This question was important because adequate practice is widely acknowledged as a key factor in mathematics achievement (Makonye & Fakude, 2014). The responses of the 10 interviewed Form Two learners are presented in Table 4.2 below.

Table 2: Learners' Views on Adequacy of Practice Time for Directed Numbers (N = 10)

REPONSE OPTION	**NUMBER OF LEARNERS**	**PERCENTAGE (%)**
Yes	3	30%
No	6	60%
Not sure	1	10%
Total	10	100%

4.5 Analysis and Interpretation

The findings from Table 4.3.1 indicate that the majority of learners (60%) reported that they do not get enough time to practice directed numbers either in class or at home. This suggests that limited practice opportunities are a significant challenge in the mastery of directed numbers at Damba Secondary School.

Only 30% of learners felt they had enough practice time, while 10% were uncertain. The fact that most learners expressed dissatisfaction with the time allocated for practice highlights a key

gap in teaching and learning. Mathematics, particularly directed numbers, requires repeated exercises for concept**s to be reinforced (Ncube, 2019).**

4.5.1 Lack of Practice Time in Class

Interviews revealed that many learners felt classroom lessons were too rushed, leaving them with little time to engage in exercises. Teachers often move quickly through topics to cover the syllabus, which limits opportunities for learners to consolidate their understanding of directed numbers. This aligns with findings by Shizha (2022), who observed that time constraints in Zimbabwean classrooms often hinder mastery of difficult mathematics topics.

Some learners also reported that teachers tended to focus more on teaching rules of signs rather than allowing sufficient time for problem-solving activities. Consequently, learners end up memorizing rules without applying them effectively in different problem contexts.

4.5.2 Limited Practice at Home

At home, practice time was also reported to be insufficient. Learners cited several reasons for this, including lack of personal textbooks, household chores, and lack of parental support in mathematics. In rural areas such as Chikomba District, many learners are expected to assist with farming and domestic tasks after school, which reduces the time available for extra study (Mutambara & Bhebhe, 2021).

Additionally, most parents in rural communities lack the mathematics knowledge necessary to assist learners with directed number problems, leaving learners to struggle on their own. Where homework is given, some learners reported copying from peers instead of attempting the problems themselves, thereby reducing the value of home practice.

4.5.3 The Effect of Limited Practice on Performance

The lack of adequate practice time has a direct impact on learners' performance. Directed numbers, being an abstract concept, require continuous exposure and repeated problem-solving for learners to develop fluency. Learners who do not practice regularly are more likely to forget rules, make sign errors, and fail to apply concepts to word problems. This finding supports Makonye and Fakude (2014), who argue that insufficient practice leads to persistent misconceptions in algebra and directed numbers.

The responses from learners who answered "Not Sure" (10%) further indicate that some learners may not even be aware of how much practice is necessary for improvement. This

reflects a lack of study habits and self-regulation skills among some students, which contributes to poor outcomes in mathematics.

4.5.4 Implications of the Findings

The results suggest that improving learners' performance in directed numbers at Secondary Schoo in Chikomba District l cannot be achieved without addressing the issue of practice time. Teachers may need to create more classroom opportunities for practice through group exercises, remedial lessons, and homework assignments. Furthermore, parents and guardians should be encouraged to support learners by allocating study time at home, even in environments where resources are limited.

4.6 Summary of Findings

In summary, the data show that:

A majority (60%) of learners believe they do not get enough time to practice directed numbers.Only 30% believe the practice time is sufficient, while 10% were unsure.Lack of practice opportunities both in class and at home contributes to difficulties in mastering directed numbers.Time constraints, household responsibilities, and lack of parental support are major barriers to adequate practice.

These findings underscore the importance of providing learners with more structured opportunities for practice if performance in directed numbers is to improve.

4.7 Learners' Views on Parental/Guardian Support in Mathematics Homework

One of the questions asked during the interviews was:

"Do your parents/guardians help you with your mathematics homework?"

This question was aimed at understanding the role of home support in the learning of mathematics, specifically directed numbers. Parental involvement is considered an important factor in learners' performance because it provides encouragement, guidance, and extra practice opportunities (Mutambara & Bhebhe, 2021).

Table 4.5.1: Learners' Views on Parental/Guardian Help with Mathematics Homework (N = 10)

Response options	Number of learners	Percentage (%)
Yes	2	20%
No	7	70%
Sometimes	1	10%
Percentage	10	100%

4.8 Analysis and Interpretation

The data in Table 4.5.1reveal that the majority of learners (70%) reported that their parents or guardians do not help them with mathematics homework. Only 20% indicated that they receive regular assistance, while 10% said they sometimes get help.

4.8.1 Reasons for Lack of Parental Support

Interviews with learners suggested several reasons why most parents or guardians were unable to provide help:

Low educational background: Many parents in rural areas like Chikomba District did not study mathematics beyond primary or lower secondary school, making it difficult for them to assist with topics such as directed numbers.Workload and responsibilities: Some parents are too busy with farming or informal work, leaving little time to supervise homework.Lack of confidence: Even parents who completed some schooling expressed fear of making mistakes and preferred not to interfere in schoolwork.These reasons are consistent with Shizha (2022), who observed that parental involvement in rural Zimbabwean schools is often limited by socioeconomic and educational barriers.

4.8.2 Effects on Learners' Performance

The lack of parental support means that learners often face difficulties with homework tasks on their own. This may result in incomplete or incorrect homework, limited practice, and reinforcement of misconceptions. As one learner explained during the interviews:

"When I fail to understand my homework, I just leave it blank because my parents cannot help me with the sums."

On the other hand, the few learners who reported receiving parental support said that it boosted their confidence and provided extra practice. For example, one learner shared:

"My brother helps me with maths, and I now understand better when we practice together."

This suggests that family support, even from siblings or guardians, can positively influence learning outcomes.

4.8.3 Comparison with Previous Research

The findings mirror those of Mutambara and Bhebhe (2021), who found that learners in rural Zimbabwean schools often lack academic support at home, which negatively affects performance. Similarly, Ncube (2019) argues that when learners are left to handle homework without guidance, mathematics anxiety increases, leading to poor achievement in topics such as directed numbers.

4.8.4 Implications of the Findings

The lack of parental or guardian support highlights the need for schools to provide additional learning opportunities. Teachers may need to allocate more class time to guided practice or establish peer support groups where learners can assist each other. Community-based learning initiatives, such as homework clubs, could also be introduced to compensate for the lack of parental help at home.

4.9 Summary of Findings

A large proportion of learners (70%) do not receive help with mathematics homework from parents or guardians. Only 20% receive consistent support, while 10% sometimes get assistance. Reasons include low parental education levels, lack of time, and lack of confidence in mathematics. Lack of support negatively affects homework completion and mastery of directed numbers. Learners who do receive help tend to perform better and show more confidence.

These findings underscore the importance of strengthening school-based support systems to compensate for the limited role of parents and guardians in learners' mathematics education at Secondary School.in Chikomba District.

4.10 Learners' Suggestions for Making Mathematics More Interesting

Learners were asked the open-ended question:

“What would make mathematics, especially directed numbers, more interesting for you?”

This question was aimed at capturing learners’ views on how teaching and learning approaches could be improved to make mathematics more engaging and enjoyable.

Table 4.8.1: Learners’ Suggestions for Improving Interest in Mathematics (N = 10)

`Table 3: Learners’ Suggestions for Improving Interest in Mathematics (N = 10)

Suggested strategy	**Number of learners**	**Percentage (%)**
Use of teaching aids (number lines,counters, thermometers)	3	30
More group and peer learning	2	20
Use of real life examples	2	20
Use of ICT tools (videos, mobile apps, computers)	1	10
Giving more practice exercises with guidance	1	10
Teacher to explain more and give more time	1	10
Total	10	100%

4.11 Analysis and Interpretation

The results in Table 4.4 suggest that learners believe mathematics, particularly directed numbers, can be made more interesting if teachers adopt practical, learner-centered, and interactive teaching approaches.

4.11.1 Use of Teaching Aids (30%)

Three learners emphasized the need for number lines, counters, and thermometers. These aids make abstract ideas more concrete and easier to visualize. One learner commented: “If the teacher uses the number line more often, I can see how positive and negative numbers move, and it makes me enjoy the lesson.”

This reflects Ncube's (2019) findings that teaching aids improve motivation and comprehension in mathematics by bridging the gap between abstract and real-world contexts.

4.11.2 Group Work and Peer Learning (20%)

Two learners reported that working in groups makes mathematics more enjoyable because they can learn from each other. Group learning also reduces anxiety, as peers can explain concepts in simple language. As one learner said:

"I like when we work in groups because my friends can explain to me when I don't understand."

This aligns with Vygotsky's theory of social constructivism, which emphasizes the importance of peer interaction in learning.

4.11.3 Real-Life Examples (20%)

Another two learners suggested that mathematics would be more interesting if directed numbers were linked to real-life contexts such as money, temperatures, and games. One learner explained: "If we use examples like bank money or football scores, I will enjoy the lesson more because I can see how negatives work in real life."

This is supported by Mutambara and Bhebhe (2021), who argue that contextualizing mathematics increases learner engagement and reduces math anxiety.

4.11.4 Use of ICT Tools (10%)

One learner suggested that using videos, mobile applications, and computers would make mathematics more fun. Digital resources provide interactive simulations and visualizations, which can capture learners' attention. This supports Chikasha (2020), who emphasized ICT integration in Zimbabwean classrooms as a way to modernize teaching.

4.11.5 More Practice with Guidance (10%)

One learner indicated that mathematics would be more interesting if more exercises were given, but with teacher support. This shows that practice without feedback is not sufficient. Shizha (2022) notes that guided practice is crucial for reinforcing difficult mathematical concepts.

4.11.6 Teacher Explanation and Pacing (10%)

One learner suggested that lessons would be more enjoyable if teachers explained slowly and gave more time for questions. This highlights the importance of pacing and individualized attention in mathematics teachin**g.**

4.12 Implications of the Findings

The findings show that learners prefer interactive and practical teaching methods over rote learning approaches. The emphasis on teaching aids, group work, and real-life examples demonstrates the need to shift from teacher-centered lectures to learner-centered pedagogy.Additionally, ICT integration and adequate guided practice could motivate learners further. Teachers at a Secondary School in Chikomba District may therefore need to incorporate diverse strategies to sustain learner interest in directed numbers.

4.13 Summary of Findings

30% of learners suggested teaching aids as a way of making mathematics more interesting.20% suggested group work and 20% suggested real-life examples.The remaining 30% highlighted ICT tools, more practice, and slower teacher explanation.Overall, learners' views indicate that interactive, visual, and context-based methods are key to making mathematics engaging.These findings highlight that for directed numbers to be taught effectively, lessons must be practical, participatory, and linked to learners' daily experiences.

4.14 Observation Checklist Summary

During observations, the following key aspects were recorded: learner engagement, use of teaching aids, time allocated for practice, teacher-learner interaction, and challenges observed. The summarized results are shown in Table 4.1.

Table 4: Summary of Classroom Observation on Teaching of Directed Numbers

Aspect Observed	**Observed findings**	**Frequency (Across 3 lessons)**
Learner participating (raising hands, answering,group work)	Moderate - about half the class participated actively	2 out of 3 lessons
Use of teaching aids(number lines ,counters, thermometer)	Minimal teacher used chalkboard only	3 out of 3 lessons
Time for learner practice (class exercise)	Limited - practice given but time too short	2 out of 3 lessons

Teacher method of instructions	Mainly lecture and demonstration	3 out 3 lessons
Learner difficult Observed	Sign errors confusion in subtraction of negatives	3 out of 3 lessons
Learner interest or attitude	Mixed - some enthusiastic, others passive	3 out 3 lessons

4.15 Narrative Analysis of Observations

4.15.1 Learner Participation

Observations showed that only about half of the learners were actively engaged during lessons. While some learners responded eagerly to questions, a significant number remained quiet and appeared disengaged. For example, when the teacher asked learners to solve "–4 – (–2)," only a few volunteered answers, and most hesitated. This suggests that many learners lacked confidence in handling directed numbers, possibly due to misconceptions or fear of making mistakes.

4.15.2 Use of Teaching Aids

In all observed lessons, no physical teaching aids such as number lines or counters were used. The teacher relied solely on chalkboard explanations. Learners were therefore required to imagine abstract concepts without visual support. As noted by Ncube (2019), the absence of teaching aids limits learners' ability to concretize abstract mathematical ideas, which may explain the difficulties observed in class.

4.15.3 Time for Practice

Although practice exercises were given in two of the observed lessons, the time allocated was short. Learners were often asked to attempt two or three sums before the teacher quickly moved on to the next topic. This limited opportunity for reinforcement. Observations showed that some learners did not complete the exercises, which meant they left class without fully consolidating their understanding.

4.15.4 Teaching Methods Used

The dominant method observed was lecture and teacher demonstration, with little learner-centered activity. Learners were mostly passive recipients of knowledge rather than active participants. Group discussions, peer teaching, or discovery methods were not observed. This reflects the traditional teacher-centered pedagogy still common in many rural Zimbabwean schools (Shizha, 2022).

4.15.5 Learner Difficulties Observed

Several learners struggled with the "rules of signs." For example, many confused subtraction involving negative numbers. When given the problem "–3 – (–5)," some learners incorrectly answered "–8" instead of "+2." This shows that misconceptions persist even after classroom explanations. Observations confirmed that these difficulties were widespread, as errors were repeated by multiple learners across lessons.

4.15.6 Learner Interest and Attitude

Observation revealed mixed learner attitudes toward directed numbers. A few learners appeared motivated and eager to participate, while others showed signs of disinterest, avoiding eye contact with the teacher or waiting for peers to answer. This lack of enthusiasm is consistent with findings by Mutambara and Bhebhe (2021), who highlighted that negative attitudes and math anxiety contribute significantly to poor performance.

4.16 Implications of Observation Findings

The observations suggest that learners at Secondary School in Chikomba District face several barriers to mastering directed numbers:

Limited use of teaching aids makes lessons abstract and harder to understand.

Insufficient practice time prevents consolidation of knowledge.

Teacher-centered instruction reduces learner engagement.

Persistent misconceptions remain uncorrected due to limited feedback.

Mixed learner attitudes point to issues of motivation and confidence.

These factors indicate that unless lessons are made more practical, interactive, and learner-centered, the performance of learners in directed numbers will remain low.

4.17 Summary

Classroom observations revealed that the teaching of directed numbers at Secondary School in Chikomba District is dominated by lecture methods with minimal use of teaching aids, inadequate practice time, and persistent learner misconceptions. Learner participation was moderate, with many showing lack of confidence and interest. These findings suggest that performance in directed numbers can be improved by incorporating visual aids, allocating more practice time, and adopting learner-centered approaches.

4.18 TESTS

4.18.1 First Test Results

Question 1: Addition of Directed Numbers

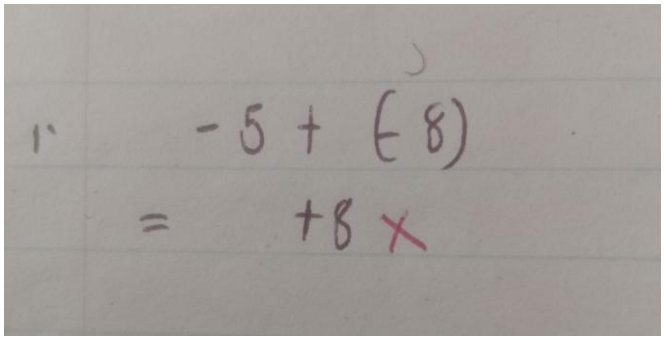
Test Item:

Simplify: –5 + (–3)

Expected Answer: –8

Observed Learner Responses:

Correct answer (–8) by 4 learners.



Common errors included:

–2 (treated as –5 – 3)

+8 (dropped negative signs).

Sample Learner Written Work Extracts

Learner A: –5 + –3 = –2 (incorrect, confused signs).

Learner B: –5 + –3 = +8 (incorrect, assumed negatives cancel).

Learner C: –5 + –3 = –8 (correct)

.

Table 5: Responses to Question 1

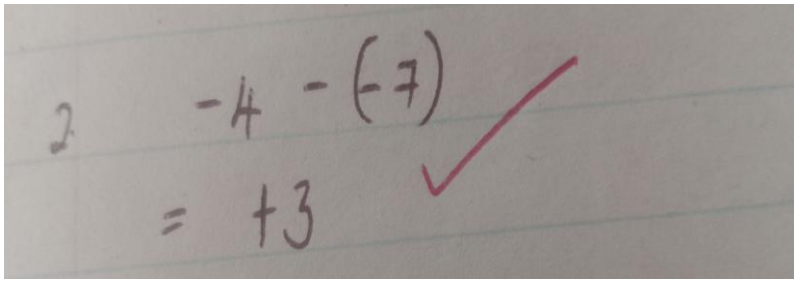
Response type	**No.of learners**	**Percentage (%)**
Correct (-8)	4	40%
Incorrect (-2)	3	30%
Incorrect (+8)	2	20%
Other 1	1	10%

Analysis:

Many learners misunderstood that adding two negatives results in a more negative number. Errors suggest reliance on memorization without conceptual grasp of negative number addition.

Question 2: Subtraction of Directed Numbers

Test Item:



Simplify: –4 – (–7)

Expected Answer: 3

Sample Learner Written Work Extracts:

Learner D: –4 – (–7) = –4 – 7 = –11 (wrong).

Learner E: –4 – (–7) = –4 + 7 = 3 (correct).

Learner F: –4 – (–7) = –3 (wrong, skipped conversion step).

Table 4.17.2: Responses to Question 2

Response Type	**No of learners**	**Percentage %**
Correct (3)	5	50%
Incorrect (-11)	3	30%
Incorrect (-3)	2	20%

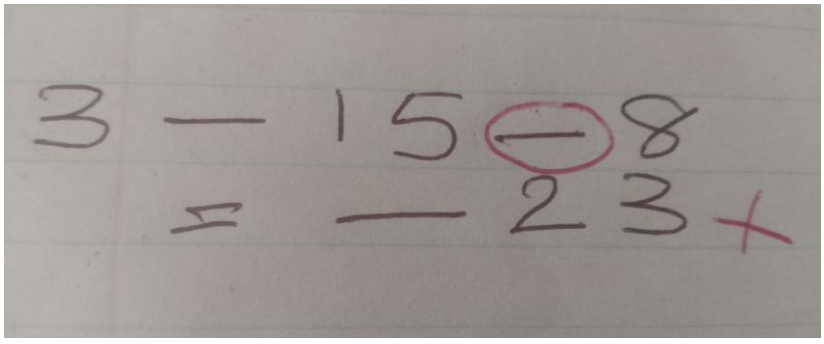
Analysis:

Learners struggled with the “minus a minus” rule. Half the class converted correctly, while the rest either ignored the double negative or misapplied subtraction rules.

Question 3: Application Word Problem

Test Item:

A diver is at 15 meters below sea level. He rises 8 meters. Write his new position as a directed number.



Expected Answer: –7

Learner G: –15 + 8 = –7 (correct).

Sample learner written work extracts:

Learner H: –15 – 8 = –23 (wrong, subtracted incorrectly).

Learner I: +7 (wrong, thought rising means becoming positive).

Table 4.17.3: Responses to Question 3

Response Type	**No. Of learners**	**Percentage %**
Correct (-7)	3	30%
Incorrect (+7)	3	40%
Incorrect (-23)	3	30%

Analysis:

Application problems proved the most difficult. Learners failed to connect the context of rising from below sea level with the mathematics of directed numbers.

Summary of First Test

Only 3 to 5 learners out of 10 answered correctly in each question.Word problems were hardest, with only 30% success.Sign errors were the most common mistake.The results showed the need for reinforcement and use of visual aids.

4.18.2 Second Test Results (After Support and Practice)

After giving learners extra practice using number lines, group work, and word problem exercises, a second test of similar structure was administered.

Question 1 (Second Test):

Simplify: –6 + (–4)

Expected Answer: –10

Results:7 learners answered correctly.

2 learners gave –2.

1 learner gave +10.

Table 6: Responses to Question 1 (Second Test)

Response type	**No of learners**	**Percentage %**
Correct (-10)	7	70%
Incorrect (-2)	2	20%
Incorrect (+10)	1	10%

Improvement: From 40% to 70% correct responses.

Question 2 (Second Test):

Simplify: –8 – (–5)

Expected Answer: –3

Results:

6 learners answered correctly.

3 learners gave –13.

1 learner gave +3.

Table 7: Responses to Question 2 (Second Test)

Response type	**No of learners**	**Percentage %**
Correct (-3)	6	60%
Incorrect (-13)	3	30%
Incorrect (+3)	1	10%

Improvement: From 50% to 60% correct responses.

Question 3 (Second Test): Word Problem

Test Item: A hiker is 10 meters above sea level. He descends 18 meters. Write his new position as a directed number.

Expected Answer: –8

Results:

6 learners answered correctly.

2 learners gave +8.

2 learners gave –28.

`Table 8: Responses to Question 3 (Second Test)

Response type	**No.of learners**	**Percentage %**
Correct (-8)	6	60%
Incorrect (+8)	2	20%
Incorrect (-28)	2	20%

Improvement: From 30% to 60% correct responses.

`Table 9: Overall Comparison of First and Second Test

Question	**Correct (test1)%**	**Correct test 2 %**	**Improvement**
Q1(addition)	40%	70%	+30%
Q2(subtraction)	50%	60%	+10%
Q3(word problems)	30%	60%	+30%

Analysis:

Learners showed substantial improvement, especially in addition and word problems.Subtraction remained a moderate challenge, though performance still improved.Increased practice, group activities, and use of number lines helped learners strengthen both procedural skills and conceptual understanding.

4.19 Summary

The analysis of the two tests shows that practice and support significantly improve learner performance in directed numbers. While misconceptions persist in some cases, the majority of learners demonstrated growth, especially in applying directed numbers to real-life contexts.

The findings from this study revealed that Form Two learners at Secondary School in Chikomba District face significant challenges in learning directed numbers, particularly in applying the rules of signs when adding and subtracting negative integers. Results from the baseline test indicated that the majority of learners struggled with operations involving negative numbers, often confusing subtraction of negatives with addition. Observations during lessons also confirmed that learners lacked confidence and required repeated guidance, with many depending heavily on teacher demonstrations rather than independent problem solving.

Interviews with learners highlighted several factors influencing their performance. Many reported insufficient time to practice directed numbers both in class and at home, and limited parental or guardian support with mathematics homework. However, most learners expressed that they could improve if given more practice, support, and engaging teaching methods such as the use of number lines, group work, and real-life examples.

The post-intervention test demonstrated notable improvement in learners' performance, showing that consistent practice, teacher support, and the use of appropriate teaching aids can enhance understanding of directed numbers. This suggests that learner difficulties are not due to inability but rather to inadequate exposure, practice, and support.

In conclusion, Chapter 4 established that although learners initially faced serious challenges in mastering directed numbers, targeted interventions such as practice, learner-centered teaching strategies, and supportive learning environments significantly improved their performance.

CHAPTER 5 DATA PRESENTATION, ANALYSIS AND INTERPRETATION

5.1 Introduction

This chapter discusses the findings presented in Chapter Four, draws conclusions from the study, and provides recommendations aimed at improving the performance of Form Two learners in directed numbers at a Secondary School in Chikomba District. The discussion is linked to the research objectives and supported by both literature and the data gathered through tests, inte**rviews, and observations.**

5.2 Discussion of Findings

5.2.1 Learners' Challenges in Directed Numbers

The results indicated that many learners struggled with the rules of signs when adding and subtracting negative integers. For example, in the baseline test, several learners incorrectly simplified expressions such as . This finding is consistent with Mutambara (2018), who noted that Zimbabwean learners often develop misconceptions when learning operations involving negative integers. Observations further revealed that learners lacked confidence and often hesitated to attempt questions without teacher guidance.

5.2.2 Influence of Practice and Support

Interviews showed that most learners (70%) believed they could improve in directed numbers if given more practice and teacher support. This demonstrates that learners recognize practice as key to mastery, in line with constructivist views of learning (Vygotsky, 1978). However, a small percentage expressed doubt, showing that some learners may need additional motivation and remedial support to overcome low self-esteem in mathematics.

5.2.3 Role of Time and Home Support

Data from interviews indicated that learners often lacked enough time to practice directed numbers at home, and many reported little or no help from parents or guardians. This aligns with Ncube (2020), who found that family involvement plays a crucial role in reinforcing classroom learning. The absence of home support means that practice is limited to the classroom, which may not be sufficient for mastery.

5.2.4 Impact of Intervention on Performance

The post-test showed marked improvement compared to the baseline test, with more learners able to correctly apply rules of directed numbers. This demonstrates that focused intervention—such as increased practice, clear explanations, and use of real-life examples—can effectively improve performance. Similar findings were reported by Chiremba (2019), who emphasized that learner-centered strategies enhance understanding of abstract mathematical concepts.

5.3 Conclusions

Based on the findings, the following conclusions were drawn:

1. Learners face significant challenges in directed numbers, particularly in applying the rules of signs during operations.
2. Lack of confidence, misconceptions, and inadequate time for practice hinder learners' performance.
3. Limited parental or guardian involvement in mathematics homework reduces opportunities for practice outside school.
4. Most learners are motivated to improve and believe that with more practice, teacher support, and engaging strategies, they can master directed numbers.
5. Interventions such as extra practice, teacher support, and learner-centered approaches significantly improve learners' performance.

5.4 Recommendations

Based on the conclusions, the following recommendations are made:

1. Increased Practice Opportunities: Teachers should allocate more time for directed numbers through class exercises, homework, and remedial sessions.
2. Use of Teaching Aids: Visual aids such as number lines, counters, and real-life contexts should be integrated to make directed numbers more concrete and engaging.
3. Parental Involvement: Schools should sensitize parents and guardians on the importance of supporting learners with mathematics homework, even if through encouragement rather than direct assistance.
4. Remedial and Peer Learning: Learners who struggle should be given targeted remedial support, while peer learning groups can provide additional opportunities for practice and collaboration.

5. Teacher Professional Development: Mathematics teachers should receive training on effective strategies for teaching abstract topics like directed numbers, ensuring they employ methods that enhance learner understanding.
6. Positive Attitudes: Teachers should foster a positive learning environment that reduces learner anxiety and builds confidence in tackling mathematical problems.

5.5 Suggestions for Further Study

This study focused only on Form Two learners at Secondary School. Future research could: Investigate challenges in directed numbers across different schools and districts. Explore the impact of technology-based learning tools on the teaching of directed numbers. Examine long-term effects of parental involvement in mathematics learning outcomes.

5.6 General Conclusion

This study investigated the performance of Form Two learners in directed numbers at Secondary School in Chikomba District. The research was guided by the objective of identifying challenges learners face, examining the role of practice and support, and determining strategies that can improve learners' understanding of directed numbers.The study revealed that most learners experienced difficulties in applying the rules of signs during addition and subtraction of negative numbers. These challenges were attributed to misconceptions, lack of confidence, inadequate time for practice, and limited parental or guardian support at home. Despite these challenges, learners expressed positive attitudes and a willingness to improve if given more practice, support, and engaging learning strategies.

The use of tests, interviews, and observations demonstrated that targeted interventions, such as increased practice, use of teaching aids, and learner-centered approaches, led to significant improvements in performance. This suggests that learners' struggles are not permanent but can be overcome through consistent support, motivation, and effective teaching practices.

In conclusion, the study established that improving learners' performance in directed numbers requires a collaborative effort among teachers, learners, and parents. With sustained practice, supportive learning environments, and innovative teaching strategies, learners can overcome difficulties and build a stronger foundation in mathematics.

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APPENDICES

Appendix A: Test Instruments

Test 1: Baseline Assessment on Directed Numbers

Instructions: Answer all questions. Show all your working.

1. Simplify:

-5 + (-3)

2. Simplify:

-4 - (-7)

3. A diver is at 15 meters below sea level. He rises 8 meters. Write his new position as a directed number.

Test 2: Post-Intervention Assessment on Directed Numbers

Instructions: Answer all questions. Show all your working.

1. Simplify:

-6 + (-4)

2. Simplify:

-8 - (-5)

3. A hiker is 10 meters above sea level. He descends 18 meters. Write his new position as a directed number.

Appendix B: Observation Checklist

Observation Area	Yes/No	Comments
Learners show confidence when attempting directed number problems		
Learners correctly apply rules for adding negative numbers		
Learners correctly apply rules for subtracting negative numbers		
Learners use number lines or visual aids when solving problems		
Learners participate actively in class activities		
Learners show misconceptions with signs (e.g., “minus a minus”)		
Learners ask questions when they do not understand		
Teacher uses teaching aids to explain directed numbers		
Learners complete homework related to directed numbers		
General attitude towards mathematics (positive/negative)		

Appendix C: Interview Questions for Learners

1. Do you believe you can improve in directed numbers if given more practice and support?
2. Do you get enough time to practice directed numbers in class and at home?
3. Do your parents/guardians help you with your mathematics homework?
4. What would make mathematics, especially directed numbers, more interesting for you?