THE IMPACT OF ACTIVITY-BASED INSTRUCTION ON GRADE 11 LEARNERS' PERFORMANCE IN ALGEBRAIC EXPRESSIONS: A CASE OF ONANKALI CIRCUIT, OSHIKOTO REGION

A THESIS SUBMITTED IN PARTIAL FULFILMENT

OF THE REQUIREMENTS FOR THE DEGREE

OF

MASTER OF EDUCATION

OF THE

UNIVERSITY OF NAMIBIA

BY

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201403539

OCTOBER 2025

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ABSTRACT

In Namibia, Mathematics education faces persistent challenges, particularly in learners' grasp of Algebraic Expressions, as evidenced by consistent underperformance in national examinations. This study investigated the potential of Activity-Based Instruction (ABI) to enhance Grade 11 learners' proficiency in Algebraic Expressions, aiming to address these mathematical deficits. This research employed a mixed-methods approach to examine the impact of ABI. Qualitative insights were gathered from Mathematics teachers in the Onankali Circuit regarding their perceptions and experiences with ABI in teaching Mathematics. Concurrently, a quasi-experimental design with non-equivalent pretest-posttest was utilised. Two Grade 11 classes, one from each of the two selected schools, in the Onankali Circuit, totalling 80 learners, participated in the study. The experimental group underwent ABI sessions, focusing on hands-on activities and interactive learning approaches, while traditional methods of instruction were utilised to teach the control group. The two groups were assessed via pre-tests and post-tests on Algebraic Expressions to gauge their performance improvements following the interventions. Statistical analysis revealed a substantial increase in the mean post-test score for the experimental group (31.55) in comparison to the mean post-test score for the control group (19.05). The results indicated that a statistically significant difference exists in the mean post-test score for the experimental group and the mean post-test score for the control group, at the significant level of $\alpha = 0.05$. This disparity highlights the effectiveness of ABI in enhancing learners' understanding and application of algebraic concepts. Mathematics teachers reported positive perceptions of ABI, noting increased student engagement and improved learning outcomes. However, challenges such as time constraints, limited resources, and technical difficulties were identified as barriers to optimal ABI implementation. These results could inform Ministry of Education to emphasise alternative teaching approaches in Mathematics education. The study recommends that mathematics teachers should be encouraged to employ ABI when teaching Algebraic Expressions, which can be facilitated by providing comprehensive training for Mathematics teachers on designing hands-on activities and implementing ABI in teaching Algebraic Expressions; and that the Ministry of Education, Arts and Culture should design a Continuous Assessment form for Mathematics Grades 10 -11, so that learners are assessed in every topic.

KEYWORDS: Activity-Based Instruction (ABI), Algebraic Expressions, Grade 11 Learners, Learners' Performance, Learners' Engagement.

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ACKNOWLEDGEMENT

First of all, I would like to thank the Almighty God for giving me strength and for being gracious to me throughout this study. He gave me courage, knowledge and wisdom to carry out this study.

I would like to extent my sincere gratitude to my supervisor Dr. Frans N. Haimbodi for his thoughtful guidance and encouragement in completing this study. Your patience, efforts, kind advice, professionalism and supervision made this study possible. I would also like to thank Dr. E. R. T Elago for his great support and guidance toward this study.

I would also like to thank the Director of Education, Oshikoto Region and the principals for the selected schools for granting me permission to conduct this study at the selected schools, as well as all the participants (teachers and learners) for their co-operation and for the vital information they provided me with.

Finally, I would like to thank my colleagues at Reverend Juuso Shikongo Secondary School, for their moral support they gave me during the course of this study.

DEDICATION

This thesis is dedicated to my parents; Mathilde Shivia and Werner Shilamba, and to my siblings. For the words of encouragement, love, unconditional support and positive attitude towards this product.

DECLARATION

I, Klaudia Nameva Shilamba, hereby declare that "THE IMPACT OF ACTIVITY-BASED INSTRUCTION ON GRADE 11 LEARNERS' PERFORMANCE IN ALGEBRAIC EXPRESSIONS: A CASE OF ONANKALI CIRCUIT, OSHIKOTO REGION" is a true reflection of my own research, and that this work, or part thereof has not been submitted for a degree at any other institution of higher education.

I, Klaudia Nameva Shilamba, grant the University of Namibia the right to produce this thesis in whole or in part, in any manner or format, which the University of Namibia may deem fit.

Klaudia Nameva Shilamba		October 2025
Name of Student	**Signature**	**Date**

ACRONYMS AND ABBREVIATIONS

MoEAC: Ministry of Education, Arts and Culture

NSSCO: Namibia Senior Secondary Certificate Ordinary Level

ABI: Activity-Based Instruction

CHAPTER 1: INTRODUCTION

This Chapter introduces the study on the Impact of Activity-Based Instruction on the performance of Grade 11 learners in Algebraic Expressions: A case of Onankali Circuit, Oshikoto Region. The Chapter outlines the background of the study and discusses the study's statement of the problem, the research questions, the research hypotheses as well as the significance of the study. It further discusses the limitations and the delimitations of the study, as well as the definitions of the keywords used in the study.

1.1 Background of the study

The relevance of Mathematics is recognised worldwide, and as it is a vital discipline, it needs to be reinforced in school as a crucial discipline to provide students with the abilities necessary for achieving success in higher education, career aspirations, and personal fulfilment (Okello, 2010). The Namibian Ministry of Education, Arts and Culture (MoEAC) views Mathematics as "a language of its own, a way of thinking and communicating which every person needs" (2016, p. 11). With the rising emphasis on science, technology, and business, learners must be completely numerate and capable of grasping and using mathematical language confidently and successfully (MoEAC, 2016).

Mathematical skills and knowledge are vital for achieving Sustainable Development Goals and Namibia's Vision 2030 (Kanandjebo, 2016). Kanandjebo further highlights that Mathematics is also regarded as a basic entry prerequisite for any of the prestigious courses, such as engineering, architecture, and medicine among other degree programs. Okello (2010) highlights some of the importance of Mathematics in education such as helping learners improve their problem-solving and analysis skills; it is used in everyday life, serves as the foundation for all technologies, and is used in a variety of occupations. Thus, every individual must have some level of proficiency in mathematics (MoEAC, 2016).

Despite its importance, Mathematics remains one of the most challenging subjects, in terms of teaching in Namibia for teachers. This may be due to the lack of effective Mathematics teaching strategies, which leads to learners finding Mathematics difficult to learn (Hamukwaya & Haser, 2021). Success in Mathematics lessons depends on how the teacher manages to choose the most suitable teaching methods to achieve the proposed learning objectives (Ardeleanu, 2019). Poor teaching methods such as the ones that do not involve learners in their learning seem to be contributing to poor performance in Mathematics, since the learning capacities of many of the learners are limited which leads to learners losing interest in learning (Noreen & Rana, 2019). Thus, to improve learners' performance in Mathematics, teachers need to shift from traditional teaching pedagogies to new teaching pedagogies such as Activity based learning, collaborative, critical pedagogy, etc. (Luitel, 2019).

Algebra is considered fundamental to the development of learners' higher order thinking skills in Mathematics and Science (McNeil et al., 2010). It is hence one of the Mathematics topics offered in secondary school in Namibia (MoEAC, 2018). Johnson and Clough (2006) define algebra as a part of Mathematics in which letters are used to represent numbers. Algebra comprises expressions, equations and inequalities. An Algebraic Expression is a Mathematics sentence which consists of terms made up of factors (D'Emiljo, 2018). Performance in Algebra is widely considered as important to learners' future performance in subsequent Mathematics courses and postsecondary education (Star

& Rittle-Johnson, 2009). Thus, Algebraic Expressions must be understood by learners in Grade 11 since it is one of the topics in the Grade 12 Advanced Subsidiary (AS) Mathematics curriculum (MoEAC, 2020a). In Namibia, the new curriculum NSSCO Mathematics was implemented in 2019, and the first examination was written in 2020 (MoEAC, 2018).

The new curriculum NSSCO Mathematics syllabus is challenging to many learners, some learners do not understand some of the specific objectives of the syllabus (MoEAC, 2020b). The examiners' reports for 2020, 2021 and 2022 indicated that ever since the new curriculum was introduced, the learners have not been performing well in NSSCO Mathematics examinations, with Algebra, Algebraic Expressions manipulation in particular, being one of the topics of concern since learners have been poorly answering questions on this topic (MoEAC, 2020b, 2021, 2022). Table 1.1 shows the statistics of how Oshikoto Region has been performing in Mathematics NSSCO since the introduction of the new curriculum.

Table 1.1: Mathematics NSSCO result analysis for Oshikoto Region

Year	2021	2022	2023	**Average %**
Total number of learners	4346	4031	4134	
% symbol A*-C	14.6	12.0	15.8	14.1
% symbol A*-D	30.7	26.4	29.6	**28.9**
% symbol E-G	55.8	54.1	49.3	**53.1**
% symbol U	13.6	19.4	21.1	**18.0**

(Source: Oshikoto Education Directorate, 2024)

Table 1.1 indicates an average of 28.9% (A*-D) over the three-year period (2021 – 2023) since the operation of the new curriculum, where mathematics is compulsory. Performance in Mathematics NSSCO dropped from 30.7% (A*-D) in 2021 to 26.4% (A*-D) in 2022, except in 2023 where there is an increase from 26.4% to 29.69% (A*-D). This shows a poor performance in Mathematics NSSCO over the three-year period, and it brings a lot of questions regarding what should be done to improve the performance.

Activity-Based Instruction focuses on learning by doing (Pokhrel, 2018). This may involve the teacher providing hands-on activities and/or games to learners, rather than just presenting the lesson for learners to listen. Luitel (2019) indicates that Activity-Based Instruction in the teaching of Mathematics is unique and effective; it attracts school children and makes Mathematics easy to understand. This teaching method can give students a sense of participation and it is also helpful in improving classroom interaction (Cariaso, 2023). Moreover, a study conducted by Ajai et al. (2013) found that learners taught Algebra utilizing instructions such as Activity-Based Instruction seem to outperform those taught using traditional approaches. However, this study was done in Nigeria and issues of this kind have not been uncovered in the Namibian setting. Learners must actively participate in their learning, and if teachers could incorporate techniques to involve learners in their own learning, learners would be more motivated to learn, and this would improve mathematics results in schools (Mukelabai, 2018).

D'Emiljo (2018) notes that learners who simply struggle with Algebraic Expressions are difficult to help and they need to be able to recognise aspects they are struggling with, to give the teacher a starting point. It is recommended that teachers should make sure that learners are given enough learning materials that provide algebraic practice from multiple viewpoints, to ensure that the learners are familiar with different types of situations and contexts that increase their algebraic manipulation skills (Kamukonda & Naukushu, 2019).

Okello (2010) encourages the use of learner-centred pedagogy instead of teacher-centred pedagogy, in the learning of algebra, whereby hands–on learning activities should be prioritised over presentations by the teacher only. Mukelabai (2018) argues that it is vital that the Namibian Ministry of Education focuses on empowering teachers with new pedagogical approaches that involve hands-on learning activities and increase learners' performance. This study was therefore carried out to assess the impact of Activity-Based Instruction on the Grade 11 learners' performance in Algebraic Expressions.

1.2 Statement of the problem

The National Curriculum for Basic Education in Namibia attaches great significance to Mathematics as a school subject. "Mathematics is an indispensable tool for everyday life, and it is also essential for the development of science, technology and commerce" (MoEAC, 2016, p.11). Mathematics is a compulsory subject in all school grades in Namibia from grades 0 to 11 and optional in Grade 12. Despite its' importance, learners do not perform well in Mathematics, particularly in Algebraic Expressions. The NSSCO examiners report indicates that learners poorly answered the questions on Algebraic Expressions and majority of them lack the know-how of Algebraic Expressions manipulation (MoEAC, 2020b). The examiners' report further highlights that Algebra was one of the topics that most of the learners displayed minimal comprehension, for example, "learners could not differentiate between an expression and an equation, hence they changed an expression into an equation" (p. 400). In addition, algebraic manipulation is one of the topics that require more attention, algebraic manipulation skills such as algebraic fractions and indices are not mastered and questions on algebraic manipulation were poorly answered (MoEAC, 2021).

While existing research has expansively explored challenges faced by learners in mastering Algebra (Sezuni, 2022), Problem-Based Learning and challenges faced by learners in retention of algebraic knowledge (Kaufilua, 2019; Kaufilua & Miranda, 2021) the prevailing issue of poor performance in Algebraic Expressions across the years has encouraged the need for an enthusiastic investigation. The study aims to investigate the impact of Activity-Based Instruction on the performance of the Grade 11 learners' in Algebraic Expressions in Onankali Circuit of Oshikoto region. The study sought to identify the impact of Activity-Based Instruction and analyse the challenges experienced by Mathematics teachers when integrating Activity-Based Instruction, in order to bring up insights to enhance learners' knowledge of Algebra and performance in Algebraic Expressions for learners in related educational settings.

1.3 Research questions

1. What are the effects of Activity-Based Instruction on the Grade 11 learners' performance in Algebraic Expressions?
2. What are the challenges experienced by Mathematics teachers when integrating Activity-Based Instruction?

1.4 Research hypotheses

In this study, the following hypotheses were tested to determine the impact of Activity-Based Instruction on the Grade 11 learners' performance at the significant level of $\alpha = 0.05$:

H_0: There is no significant difference in the Grade 11 Mathematics learners' performance in Algebraic Expressions between those who are taught utilising Activity-Based Instruction and those who are taught utilising the traditional method only ($\mu_1 = \mu_2$)

H_1: There is a significant difference in the Grade 11 Mathematics learners' performance in Algebraic Expressions between those who are taught utilising Activity-Based Instruction and those who are taught utilising the traditional method only ($\mu_1 \neq \mu_2$).

1.5 Significance of the study

This study's findings may provide the impact of Activity-Based Instruction on the learners' performance in Algebraic Expressions. The findings of this study may contribute to the literature on Activity-Based Instruction and serve as a helpful resource for others who wish to assess the impact of Activity-Based Instruction on learners' performance in other Mathematics topics, subjects, or regions. The study could add to the body of existing knowledge concerning using Activity-Based Instruction in teaching Algebraic Expressions. Additionally, the study could inform Mathematics teachers about the appropriate teaching methods that enhance understanding of Algebraic Expressions and help them to understand the method of Activity-Based Instruction which might enhance learners' performance in Mathematics.

1.6 Limitations of the study

Firstly, the study was carried out at secondary schools in Onankali Circuit, thus the study's findings were not generalised to schools outside Onankali Circuit, although the schools outside Onankali Circuit may learn from this study, on the effects of Activity-Based Instruction on the Grade 11 learners' performance in Algebraic Expressions. Secondly, this study depended on the availability of literature on Activity-Based Instruction, and the willingness and cooperation of the learners to participate. Lastly, the ability of learners to master activities and apply the knowledge to solve given mathematical problems as well as the time taken for learners to do and repeat the given activities were also limitations of the study.

1.7 Delimitations of the study

The study focused only on Grade 11 learners, from the two selected secondary schools, and Mathematics teachers, in Onankali Circuit.

1.8 Definition of terms

Impact– in this study the word "impact" refers to an effect or influence Activity-Based Instruction has on the grade 11 learners' performance in Algebraic Expressions.

Activity-Based Instruction – is a method/strategy of teaching that includes learners in the teaching–learning process, where activities of different types, relevant to specific subjects are integrated (Hassan, 2016). In this study Activity-Based Instruction refers to a technique of teaching and learning that involves teachers providing learners with hands-on activities and learners learning by doing during Mathematics lessons.

Performance – is accomplishing or achievement of specific goals, objectives in any academic undertaking (Michael, 2015). In this study, it refers to the scores in Algebraic Expressions tests of Grade 11 learners in Onankali Circuit.

Algebra – is a collection of letters and numbers linked by addition, subtraction, multiplication, and/or division (D'Emiljo, 2018). In this study Algebra refers to a part of mathematics that deals with letters and numbers connected and operations.

Algebraic Expression – is a Mathematics sentence which consists of terms made up of factors. In this study it refers to a statement that consists of terms and algebraic operations (D'Emiljo, 2018). In this study it refers to a statement that consists of terms and algebraic operations.

Traditional teaching method - A teaching approach in which teachers speak while learners listen and take notes (Festus, 2013). In this study, the traditional teaching method is defined as an instructional method whereby a teacher guides learners through explaining and demonstration without hands-on activities that allow learners to learn by doing.

CHAPTER 2: THEORETICAL FRAMEWORK AND LITERATURE REVIEW

This Chapter introduces the theoretical framework and reviews the literature relevant to the topic. First, the Chapter introduces the theoretical framework, or theory, on which the investigation is based. Secondly, it reviews the literature, where it presents the history of teaching as well as learning of Algebra, overview of Activity-Based Instruction, the benefits of using Activity-Based Instruction in teaching and learning Algebraic Expressions as well as the challenges experienced when practising Activity-Based Instruction. It further looked into traditional teaching methods.

2.1 Theoretical framework

This study is informed by Bruner's constructivist theory of learning. Bruner's Constructivist Theory states that learners are active problem solvers, capable of researching difficult subjects, and refers to the structure of knowledge as a link between factual aspects and teaching and learning approaches (Bruner, 1960, as cited in Kanandjebo, 2016). According to Bruner, a learner's intellectual development depends on receiving proper teaching and actively participating in the learning process, including hands-on activities.

According to Bruner's constructivist theory, children are believed to develop from enactive to iconic to symbolic representation when learning new content (McLeod, 2024). Enactive representation refers to learning through actions (Kanandjebo, 2016). This corresponds with Oribhabor (2020) who emphasises learners’ active learning through various hand-on activities and experiences that involve them in the lesson and promote learning by doing.

Over the past 50 years, constructivism has been fervently promoted, and during that time, educational reforms and new emphasis on the objectives of education have emerged (Rannikmae et al., 2020). Constructivism, a learning theory from psychology, emphasizes that learning is the result of mental construction, which clarify how individuals gain knowledge and learn (Olusegun, 2015). Olusegun further indicated that constructivists believe that learning is affected by the context in which an idea is taught.

Constructivism is a teaching approach that encourages learners to actively get involved in their own learning (Rannikmae et al., 2020). This is supported by one of the core skills for fulfilling Namibia’s Vision 2030, which is learning to learn, emphasises that learners gain the ability to organise, manage, and assess their own learning in order to gain and apply knowledge and skills, or to use current knowledge and abilities in new situations or in novel ways (MoEAC, 2016). Learners do this when they are actively involved in their own learning; which involves teachers providing learners with a lot of activities during the learning process (Kaufilua, 2019).

2.2 Teaching and learning of Algebra

Algebra proficiency is widely regarded as an important milestone in learners' secondary school years (Star & Rittle-Johnson, 2009). Algebra has historically been a key stumbling block in Mathematics classroom, and research on the development of Algebra instruction in the twentieth century demonstrates that secondary school Algebra studied in secondary school has not changed over the years (Kieran, 1992 as cited in Star & Rittle-Johnson, 2009). Kieran further indicates that historically, Algebra has been learners' first prolonged introduction to the abstraction and symbolism that make Mathematics strong. Besides its central role in the discipline of Mathematics, Algebra is also an important "gatekeeper" course, in that a passing grade has become an actual requirement for many educational and career prospects (Star & Rittle-Johnson, 2009).

Star and Rittle-Johnson (2009) indicate that learning Algebra presents various problems for teachers, schools and districts, but when choosing a curriculum, teachers and districts frequently have to choose between several options with little proof. Star and Rittle-Johnson (2009) further highlight that before discussing instructional approaches aimed at enhancing Algebra performance and comprehension, it is necessary to clarify our grasp of the subject.

Kaufilua (2019) examined the effects of Problem-Based Learning (PBL) on Grade 11 learners' retention of Algebra knowledge and emphasised on effective teaching and learning methods that encourage learners' active participation and other learner-centred approaches. His study recommends the use of instructional methods that optimise the cognitive memory weight and improve students' comprehension, interest, and retention of information.

Festus (2013) did carried out a study focusing on activity-based learning strategies in the Mathematics classroom in Nigeria and suspected that the pedagogy of the teachers has a significant effect on the mathematical performance of the learners. Festus criticised traditional or conventional methods of teaching due to the fact that the method has been revealed by research as being ineffective. Festus (2013) concluded that teachers of mathematics ought to switch from conventional teaching techniques to activity-based learning approaches.

2.3 Algebra in Namibian classrooms

In Namibia, algebraic problems pose a significant obstacle for many learners, since many examiners' reports indicate that learners do not fairly tackle algebraic word problems in examinations (Iilonga & Ogbonnaya, 2023). In their study, Iilonga and Ogbonnaya (2023) revealed that majority of learners were unable to answer algebraic word problems using the proper problem-solving techniques, and they lacked the necessary methods to do so.

The study conducted by Suzeni (2022) on Investigating Mathematics Teachers' Strategies for Addressing Grade 12 Learners' Challenges revealed that the lack of problem-solving abilities, improper use of instructional methodologies and bad attitudes towards the topic of Algebra are the primary obstacles that learners face when attempting to solve algebraic problems. Ineffective teaching leads to poor problem solving in Algebra by learners and, eventually, poor achievement in Mathematics, hence effective teaching tactics are required to fix the situation (Chirimbana et al., 2023).

2.4 Activity-Based Instruction

2.4.1 The overview of Activity-Based Instruction

Hassan (2016) defines Activity-Based Instruction as a method of instruction that involves learners in the teaching–learning process, where activities of different types, relevant to specific subjects are integrated. This teaching technique emphases on active learning through activities and hands-on experiences, encouraging learner engagement in the class and focuses on learning by doing (Oribhabor, 2020).

The technique enables individuals to develop their own understanding by combining prior knowledge and new experiences (Hassan, 2016). Hassan further indicates that the

Activity-Based Instruction is a learner-centred educational technique which has proven to be more effective than a teacher-centred approach. Hands-on learning activities should be encouraged instead of lectures alone (Okello, 2010). Thus, to encourage the learners, teachers must move from utilising traditional teaching strategies to utilising effective teaching methods such as Activity-Based Instruction (Festus, 2013 & Luitel, 2019).

A study conducted by Pokhrel (2018) reports that learning mathematics through activities benefits learners' overall growth as well as their ability to study the subject. Pokhrel observed that learners utilise their leisure time with activities and concluded that activities are excellent for teaching Mathematics and other skills needed for the 21st Century. Pokhrel (2018) further indicates that to improve Mathematics performance, a practical and activity-based teaching style ought to be utilized.

Bruner (1960) as cited by Kanandjebo (2016) recommended that Instruction should include appropriate learning resources to increase interest in learning. When learners are provided with activities to work on, they get involved in their own learning and gain interest in the subject and this enhances their achievement in the subject.

2.4.2 The benefits of using Activity-Based Instruction in the teaching and learning of Algebraic Expressions

A study done by Çelik (2018) in Turkey on Activity Based Mathematics Education found that Activity-Based Instruction enhances academic results of learners and perspectives on activities when it was used more than traditional approaches when teaching the Mathematics. Çelik (2018) concludes that implementing activity-based learning strategies in the Mathematics curriculum improves academic achievement rates for the learners.

Activity-Based Instructional is learner-centred as it enables learners to actively take part in their own learning. Learning becomes enjoyable and lasting if a child is allowed to explore the classroom independently and is provided the best possible conditions (Hassan, 2016). MoEAC (2016) supports learner-centred education, which is described to be a text-rich and visually and tactilely rich atmosphere for learning, to be considered in the Namibian context and also, indicated that learners learn fast when they actively participate, contribute, and produce at a high level in the learning process.

Albadi and David (2019) investigated the impacts of activity-based learning on motivation and academic achievement of learners and their study concluded that activity-based strategies may lead to higher student achievement and positive perceptions than traditional strategies. Albadi and David's study indicates that activity-based learning promotes long-term learning through direct experience. Albadi and David (2019) further attribute this enhancement to learners' character in assisting each other during the learning process.

Oribhabor (2020) evaluated the "effect of activity-based method of teaching mathematics in Nigerian secondary school students' achievement in Mathematics", and the study finding indicated that a significant difference existed in the Mathematics performance post-test mean scores of students taught utilizing the activity-based method and students taught utilizing the lecture method, with the students taught using activity-based method outperforming the students taught using the lecture method, in terms of post-test Mathematics academic success scores. Oribhabor's (2020) study found that Activity-Based teaching approaches in Mathematics have been shown to improve student academic success compared to lecture methods, the reason being doing a lot of activities in

Mathematics lessons encourages learners to work hard and by doing this it boosts student motivation and interest.

Silas (2013) investigated the “effects of learning styles on Grade 11 learners' performance in Mathematics at one senior secondary in Oshana education region” and concluded by advising teachers to experiment with different teaching tactics to identify the most effective approach for their learners' learning styles. Despite this, teaching with hands-on activities is poorly understood and implemented and further research is required on the impacts of Activity-Based Instruction in Namibia. Thus, this study concentrated more on Activity-Based Instruction as a teaching and learning method.

2.4.3 Challenges experienced when practising Activity-Based Instruction

A study conducted by Luitel (2019) indicates that most of the trained teachers showed their laziness to use the Activity-Based Instruction in Mathematics. They prefer using their own traditional pedagogies. However, changing teaching methods can boost students’ engagement and motivation by encouraging active participation in their learning rather than just listening passively (Albadi & David, 2019).

Moreover, many teachers often struggle with identifying and implementing successful activity-based learning strategies in the mathematics classroom (Festus, 2013). Thus, most teachers may prefer to use traditional teaching approaches (Çelik, 2018). The study conducted by Çelik also found packed courses, limited time, insufficient materials, and inadequate facilities as factors that challenge the integration of Activity-Based Instruction.

2.5 Traditional teaching methods

In contrast to Activity-Based Instruction there are traditional methods of instruction such as the lecture method. Traditional teaching methods are still widely used in schools. Traditional teaching methods occur when learners are guided by a teacher, where the teacher takes the lead role and the learners are typically seated such that everyone clearly understand the teacher in front of the class (Ardeleanu, 2019). The bulk of learners' learning abilities are limited since the only thing that can be learnt is to copy what is written on the board, and learners lack the ability to process facts through thought, evaluation, and exploration, which leads to the learners losing interest in learning (Noreen & Rana, 2019).

These methods use a teacher-centred approach whereby the teacher lectures while learners passively receive information (Oribhabor, 2020). Learners are primarily responsible for taking notes and remaining on the seat to respond to teacher enquiries in class, with no opportunity to display their work (Noreen & Rana, 2019). Traditional teaching methods lead to non-cognitive engagement of learners and rely on the teacher's strategies during class discussions (Sibuku & Mukwambo, 2019). Luitel (2019) indicates that traditional teaching methods instil a negative perception regarding Mathematics; learners struggle to comprehend and absorb the concepts provided.

2.6 Chapter Summary

The literature supports the use of ABI in teaching Mathematics. The common statement is that ABI involves learners in the teaching and learning process and enhances learners' performance in Mathematics. Using various learning styles in a classroom helps teachers to know which approach best fits their learners. Literature also revealed that Activity-Based Instruction needs to be used to improve learners' performance in Algebraic Expressions. This study, therefore, sought to examine the impact of Activity-Based Instruction on the Grade 11 learners' performance in Algebraic Expressions.

CHAPTER 3: RESEARCH METHODOLOGY

This Chapter outlines the methodology employed in the study. The research design and the methods used to choose the study venue and participants are discussed first. The Chapter further discusses data collection tools and methodologies. Data analysis methodologies and research ethics are also covered.

3.1 Research design

This study used a mixed-methods approach and sought to assess the impact of Activity-Based Instruction on the performance of the Grade 11 learners in Algebraic Expressions in Onankali Circuit. A mixed-methods research methodology comprises gathering and interpreting quantitative and qualitative data (Creswell, 2014). The qualitative part of the study surveyed the perspectives of Mathematics teachers, in Onankali Circuit, on employing Activity-Based Instruction as a teaching approach in Mathematics classrooms. The study utilized a non-equivalent pre-posttest quasi-experimental approach for its quantitative component. Two groups, the experimental group and the control group, were chosen from two schools in Onankali Circuit, in such a way that the control group was from one school and the experimental group from the other school. To assess the effectiveness of Activity-Based Instruction, a pre-test was given to both groups followed by intervention and then a post-test was given after all, at their respective schools.

The non-equivalent design was used since classrooms exist already and could not be randomly assigned, randomization only took place at intervention level where classes were randomly assigned to either the experimental group or the control group (Creswell, 2014). The two groups were taught by the researcher, at their respective school, the same content but using different instructional strategies, which are detailed later in this Chapter. While the experimental group got Activity-Based Instruction, the control group was instructed using conventional teaching techniques.

3.2 Population

The study contained all 371 Grade 11 learners at the six secondary schools in Onankali Circuit of the Oshikoto Region in the year 2023. The population further included all the eight secondary school Mathematics teachers in the Onankali Circuit.

3.3 Sample and sampling procedures

A sample is a smaller group or subset of the total population under study, where the researcher obtains data in such a way that the knowledge collected is reflective of the entire population under study (Louis et al., 2011). This study comprised 80 Grade 11 learners from the two schools that have government hostels in Onankali Circuit in 2023. The schools were conveniently selected on the basis that they have hostels for easy accessibility of the learners since all learners are in the hostel making it easier conduct interventions during the afternoons.

Simple random sampling was utilized to choose one Grade 11 class from each of the two schools and each Grade 11 class stood as a class group, one class as control group and the other one as experimental group. Pseudonyms were assigned to the two class groups in order to conceal the students' identities. Group A stood for the control class group, and Group B for the experimental class group. Both groups consisted of 40 learners and made up a total of 80 learners. Since the population of the secondary school Mathematics teachers in the Onankali circuit was relatively small, the study used a total sampling method and involved eight secondary school Mathematics teachers to avoid losing out on valuable information participants could contribute to the study.

3.4 Research instruments

3.4.1 Mathematics pre-test and post-test

Mathematics pre-test and post-test were developed from the Mathematics NSSC Ordinary level grades 10 - 11 syllabi's specific objectives on Algebraic Expressions manipulation. The aim for the pre-test and post-test was to measure the learners' understanding of Algebraic expressions before and after intervention respectively and determine whether a statistically significant difference occurred between the score of the control group and the score of the experimental group. Each test was out of 50 marks which lasted for 90 minutes and the marks were recorded to permit the researcher to calculate means and t-tests, to determine the impact of the intervention.

3.4.2 Questionnaire

A questionnaire with closed-ended (five-point Likert rating scale) and open-ended questions was developed to determine the challenges encountered by Mathematics teachers during Activity-Based Instruction as well as their perspectives on how Activity-Based Instruction could be better used to enhance classroom learning and performance.

The questionnaire was developed in such a way to answer the research questions 1 *"What are the effects of Activity-Based Instruction on the learners' performance in Algebraic Expressions?"* and 2 *"What are the challenges experienced by Mathematics teachers when integrating Activity-Based Instruction?"*. The questionnaire was separated into three sections: Section A consisted of four questions on biographical information. Section B consisted of twelve Likert-scale items on Activity-Based Instruction in teaching Mathematics. Section C consisted of six open-ended questions on the teachers' perspectives on Activity-Based Instruction.

3.5 Pilot study

A pilot study is crucial to obtain preliminary data, determine sample sizes and tests the viability of the study's procedures and instruments (Creswell, 2014). The pre-tests and post-tests were piloted with the Grade 11 learners at another school in Onankali Circuit in Oshikoto Region, where the learners stay in the hostel. Following a pre-test, classes were assigned to either the experimental group or control group randomly before the intervention. A post-test was then conducted following the intervention. The pilot study also involved some secondary school Mathematics teachers in the Oshikoto region that were not targeted to take part in the main study to determine whether the questionnaire would elicit the intended responses. This was done with the purpose of testing and filtering the research instruments to ensure that the instruments were clear and did not lead to misinterpretation, and also to ensure relevant and reliable data collection.

The questionnaire was properly understood and answered by respondents, resulting in no subsequent revisions. However, it was found that the time allocated per lesson was not enough, since the researcher could not finish teaching the content as expected. During the main study, the researcher added ten minutes to each lesson, and each lesson lasted for 50 minutes. It was also discovered that the Mathematics pre-test had one more mark than the Mathematics post-test. A question was omitted from the Mathematics pre-test to ensure equal weightage of scores in the main research.

3.6 Validity and reliability

Reliability refers to the consistency of the scores obtained from one administration to the other and from one set of items to another (Fraenkel et al., 2012). To establish whether the instruments measured what they were intended to measure, the study relied on content and construct validity procedures (Louis et al., 2011). The same pre-test and post-test developed by the researcher were administered to each group to guarantee fairness. The validity of the instruments was assessed by the Heads of Department of Mathematics at the selected schools and the education officer for mathematics for Oshikoto region for the purpose of ensuring clear questions, construction and arrangement of questions and proper language usage. The instruments were piloted afterward in order to test and ensure reliability. Furthermore, the lesson plans that were used were moderated by the Heads of Department at the selected schools and the instruments were approved by the supervisor.

3.7 Data collection procedures

3.7.1 Pre-test

A pre-test was given the two groups prior to intervention at the same time, with the aim of testing learners' prior knowledge of Algebraic Expressions. The test was developed based on the following Mathematics NSSC Ordinary level grades 10-11 syllabus' specific objectives on Algebraic Expressions manipulation:

- Multiply a monomial by a polynomial
- Use brackets and extract common factors
- Expand products of algebraic expressions
- Factorise where possible, expressions of the form: $ax + ay$, $ax + bx + kay + kby$, $a^2x^2 - b^2y^2$, $ax^2 - bx + c$.
- Manipulate algebraic fractions, e.g.: $\frac{x}{3} + \frac{x-4}{2}$, $\frac{2x}{3} - \frac{2}{x-3}$, $\frac{3a}{4} \times \frac{5ab}{3}$ and $\frac{1}{x-2} - \frac{2}{x-3}$.
- Factorise and simplify expressions such as: $\frac{x^2-2x}{x^2-5x+6}$; $\frac{x^2-3x-10}{x^2-4x+5}$
- Write quadratic expressions in the form $a(x + p)^2 + q$.

(MoEAC, 2018, p. 18)

3.7.2 Intervention

The participants were then taught in their respective groups using different teaching methods, at the selected schools for a period of two weeks. The lessons were taught in the afternoon to ensure that normal teaching and learning had not been disturbed. The lessons were planned and taught based on the following Mathematics NSSC Ordinary level grade 10-11 syllabus' specific objectives on Algebraic Expressions manipulation:

- Multiply a monomial by a polynomial
- Use brackets and extract common factors
- Expand products of algebraic expressions
- Factorise where possible, expressions of the form: $ax + ay$, $ax + bx + kay + kby$, $a^2x^2 - b^2y^2$, $ax^2 - bx + c$.
- Manipulate algebraic fractions, e.g.: $\frac{x}{3} + \frac{x-4}{2}$, $\frac{2x}{3} - \frac{2}{x-3}$, $\frac{3a}{4} \times \frac{5ab}{3}$ and $\frac{1}{x-2} - \frac{2}{x-3}$.
- Factorise and simplify expressions such as: $\frac{x^2-2x}{x^2-5x+6}$; $\frac{x^2-3x-10}{x^2-4x+5}$
- Write quadratic expressions in the form $a(x+p)^2 + q$.

(MoEAC, 2018, p. 18)

The lessons were planned and taught in the same order as the objectives listed in the NSSC mathematics syllabus. The mathematics post-test was given to both the two groups simultaneously following intervention. Mathematics teachers from the selected schools assisted by invigilating the pre-test as well as the post-test.

3.7.3 Experimental group: Activity-Based Instruction

The method of instruction that was used to teach the experimental group was guided by Bruner's Constructivist Theory which stipulates that learners are capable of problem-solving and exploring tough subjects, and understand the structure of knowledge as a relationship between facts and instructional strategies (Bruner, 1960, as cited in Kanandjebo, 2016). Bruner believed that what controls the intellectual development of the learners is the degree to which they have been given suitable instructions together with practice or learners active participation in the learning process which includes giving hands-on activities.

The experimental group was taught utilising Activity-Based Instructional method which allowed the learners to get involved actively in the learning process and interact with each other and the teacher, as they do different activities on Algebraic expressions. Each lesson was 50 minutes long, whereby in the first 20 minutes, the researcher emphasised on the objectives of the lesson and taught by explaining and working out different examples on the board on Algebraic expressions. During the last 30 minutes of each lesson, the learners were provided with more examples to work out on the board and activities to work on.

3.7.4 Control group

The control group was taught exclusively utilizing traditional teaching approaches only such as explanation, demonstration on the chalkboard (talk and chalk) and discussion with the teacher to understand the manipulation of Algebraic Expressions (see lesson plan, appendix L). This deductive approach involves giving full theoretical knowledge to learners, and asking them to apply it in solving mathematical problems (Abisai, 2018).

Like the experimental group, each lesson was 50 minutes long, but the researcher spent all the 50 minutes explaining and demonstrating on the chalkboard after emphasising on the objectives of the lesson. The researcher also guided the learners to listen and take notes throughout each lesson.

3.7.5 Mathematics post-test

The experimental group and control group wrote a post-test for the same duration, which was given after intervention. The post-test had the same number of questions and marks, and assessed the same content and had the same difficulty level as the first test, to guarantee reliability and validity. After the test was written, the Mathematics post-test paper scripts were collected and marked by the researcher.

3.7.6 Questionnaire

The questionnaire is a popular and practical tool for gathering survey data which provides organized, frequently numerical data, utilised without the company of a researcher (Louis et al., 2011). In this research, a questionnaire was administered to eight secondary school Mathematics teachers to indicate the challenges they encounter during Activity-Based Instruction as well as their perspectives on how Activity-Based Instruction could be better used to enhance classroom learning and performance. The questionnaires were shared via a link (google forms) to the Mathematics teachers to complete.

3.8 Data analysis

In non-equivalent control group design quasi-experimental design, the researcher had to find out whether the treatment made a significant difference in the learners' performance in Algebraic Expression as compared to the control group. This was done by testing the hypothesis using the inferential statistics. This study used t-test to find out whether a significant difference existed in the Grade 11 Mathematics learners' performance in Algebraic Expressions between the two groups selected at probability level $\alpha = 0.05$. Firstly, the t-test was used to test the significance in the Mathematics pre-test scores of the experimental group and control group to determine whether the two groups were equivalent before intervention. Finally, the t-test was used to test whether there was a significant difference in the Mathematics post-test scores of the experimental group and the control group.

On the other hand, qualitative data from the questionnaires were also scrutinised. To understand data collected from open-ended questions, the data were coded by hand in preparation for analysis since participants were few (Creswell, 2014 & Louis et al., 2011). After coding, the analysis was done by combining the data into themes and sub-themes. The data collected from closed-ended questions were analysed using frequency tables and textual descriptions.

3.9 Ethical considerations

The University of Namibia's Decentralised Ethics Committee issued the ethical clearance certificate (Appendix A). The researcher sought permission from the Ministry of Education, Arts and Culture (MoEAC) through the Director of Education, Oshikoto region. When the permission was granted, the researcher submitted the ethical clearance certificate and the letter for approval to conduct the study from the Director of education to the principals of the selected schools.

The researcher made the purpose and procedures of the study clear to participants and allowed participants to sign consent and assent forms. Participants younger than 16 years, their parents had to sign a consent and assent forms, to be permitted to take part in the study. Participants participated voluntarily and were free to withdraw from the study whenever they thought it was necessary without any negative consequences.

The participants were assured of confidentiality, which refers to a way of protecting a participant's right to privacy (Louis et al., 2011). Anonymity means not using the names of the participants or any other personal mean of identification (Louis et al., 2011). To assure anonymity, the participants were given pseudonyms to safeguard their identities. Neither the final thesis report nor the questionnaires included the teachers' names. The study was not in any way harmful to the participants, either psychologically or physically. The researcher also promised to remain objective and honest throughout the study. The test papers and any other documents with raw information and participants' identity are to be kept safe and only disposed after the completion of the study.

CHAPTER 4: PRESENTATION AND DISCUSSION OF RESULTS

4.1 Introduction

This study sought to examine how Activity-Based Instruction affected the performance of the Grade 11 learners in Algebraic Expressions. Thus, to gather data, two tests were given to learners and a questionnaire was completed by senior secondary Mathematics teachers. This Chapter presents results and discusses findings from the results of the data gathered from the two tests and questionnaire in an attempt to answer the research questions which are: *"1) What are the effects of Activity-Based Instruction on the Grade 11 learners' performance in Algebraic Expressions? 2) What are the challenges experienced by Mathematics teachers when integrating Activity-Based Instruction?"*. This Chapter is separated into two parts; Part A presents the quantitative results and discusses the outcomes of the pre-test and post-test, aimed at answering research question 1. Part B presents and discusses results from the questionnaire, aimed at answering research questions 1 and 2. Part A presents evidence for the effectiveness of Activity-Based Instruction by contrasting the experimental and control groups' pre-test and post-test mean scores.

4.2 Biographical information of participants

This section presents the biographical information of the participants. The participants were 80 Grade 11 learners and eight Senior Secondary Mathematics teachers in Onankali Circuit of Oshikoto Region. The biographical information for learners and teachers is presented in the subsections below.

4.2.1 Learners' biographical information

A sample of 80 Grade 11 learners that are doing Mathematics from two schools in Onankali Circuit, Oshikoto Region participated in the study. Table 4.1 below shows the biographical information of the learners.

Table 4.1: Biographical information of learners, Group B: Experimental group and Group A: Control group

Gender	Group		Total	Percentage (%)
	Group B: Experimental Group	Group A: Control Group		
Male	19	16	35	43.75
Female	21	24	45	56.25
Total	40	40	**80**	**100**

Table 4.1 displays the number of learners that took part in the study at the selected schools. The participants were divided into the experimental group and the control group, whereby the experimental group consisted of 40 learners from one school and the control group consisted of 40 learners from the other school, totalling 80 learners. The experimental group comprised of 19 male and 21 female learners, while the control group comprised of 16 male and 24 female learners. This gives a total of 35 male learners and 45 female learners which means most learners who participated in the study were females

with a total percentage of 56.25% while 43.75% of the participants were male learners. All 80 learners took both the pre-test and post-tests.

4.2.2 Teachers' biographical information

Eight teachers took part in the study. This subsection presents the gender, age, years of experience and teaching qualifications of the participants.

4.2.2.1 Gender

Table 4.2 reveals that a total of eight Mathematics teachers participated in the survey, with three females and five males.

Table 4.2: The Gender of the teacher participants

Gender	Frequency	Percentage (%)
Female	3	37.5
Male	5	62.5
Total	8	100

4.2.2.2 Age of Teachers

Table 4.3 summarizes the respondents' age groupings. In Table 4.3, it can be seen that only participants from two age groups took part, the age group of 25 – 35 years has the highest frequency of seven, and the age group of 36 – 45 years with the lowest frequency of one.

Table 4.3: The age of the participants

Age group	Under 25	26 – 35	36 – 45	46 – 55	56 +	Total
Frequency	0	7	1	0	0	8

4.2.2.3 Years of teaching experience

Figure 4.1 presents the number of years of teaching experience of the teachers for Mathematics that partook in the study. Figure 4.1 shows that five of the Mathematics teachers had 0 – 5 years of teaching experience. This was followed by years of teaching experience of 6 – 10, 11 – 15, and 16 – 20 years, with a Mathematics teacher only.

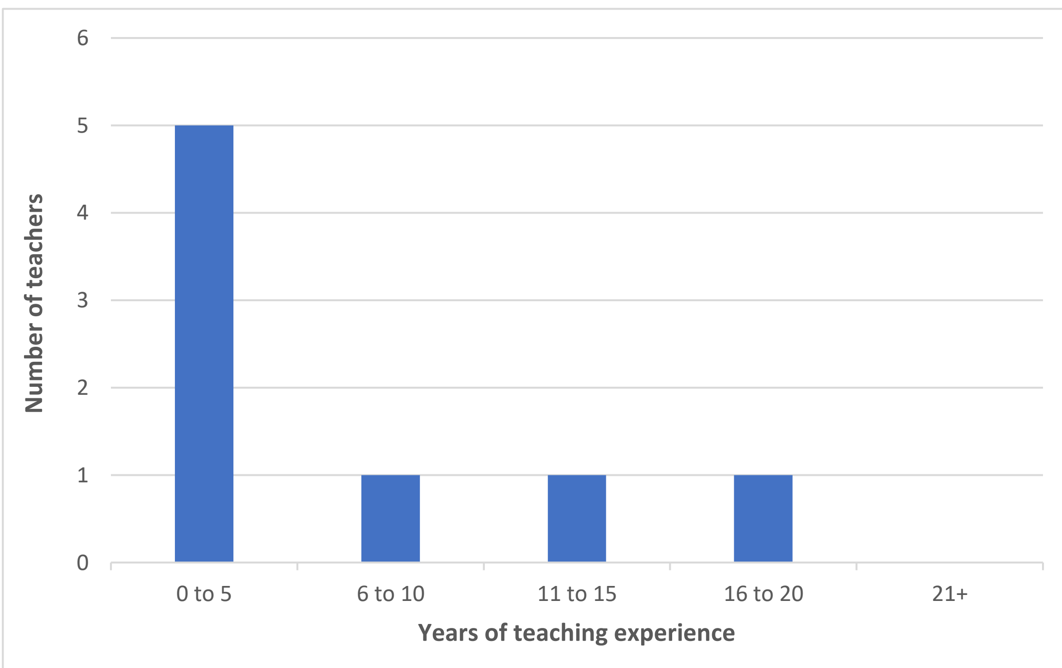

Figure 4.1. The years of teaching experience of Mathematics teachers in Onankali Circuit

4.2.2.4 Educational qualification

The qualifications of the Mathematics teachers that participated in the study are summarised in Figure 4.2. Six teachers had a Bachelor of Education (Honours) degrees and one of the teachers had a Master of Education. One of the teachers had a Teaching Diploma.

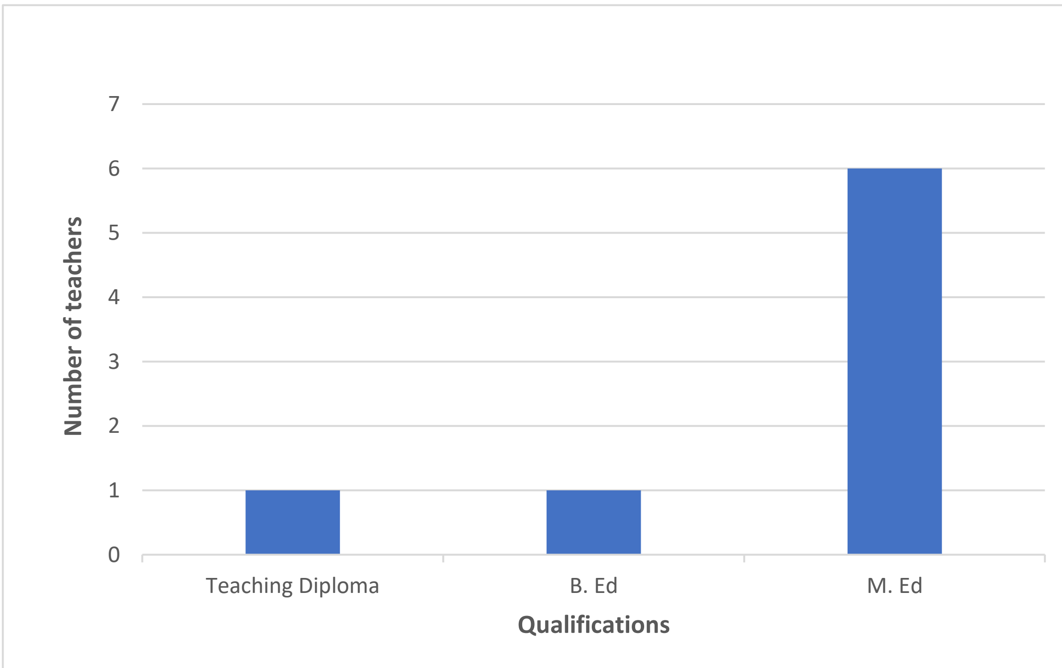

Figure 4.2. The qualifications of Mathematics teachers in Onankali Circuit.

4.3 PRESENTATION OF QUANTITATIVE DATA

The study administered Mathematics pre-tests (see Appendix I) and post-tests (see Appendix J) to Grade 11 learners at the selected schools. The results were utilised to assess the impact of Activity-Based Instruction based on the performance. The results are presented in this part of the study.

4.3.1 Pre-test results

To measure the learners' performance prior to intervention, the learners in the experimental group and the control group wrote a pre-test. The pre-test scores for the two groups are provided in Appendix K. The following hypotheses were tested to determine if a significant difference existed between the scores of the pre-test of the two groups.

H₀: There is no significant difference in the Grade 11 Mathematics learners' performance in Algebraic Expressions between the control group and the experimental group ($\mu_{1a} = \mu_{2a}$).

H₁: There is a significant difference in the Grade 11 Mathematics learners' performance in Algebraic Expressions between the control group and the experimental group ($\mu_{1a} \neq \mu_{2a}$).

The Mathematics pre-test was written by both the control group and the experimental group to discover gaps in the participants' previous knowledge of Algebraic Expressions. The scores from the pre-test for the control group and the experimental group were compare, utilising a box and whisker plot.

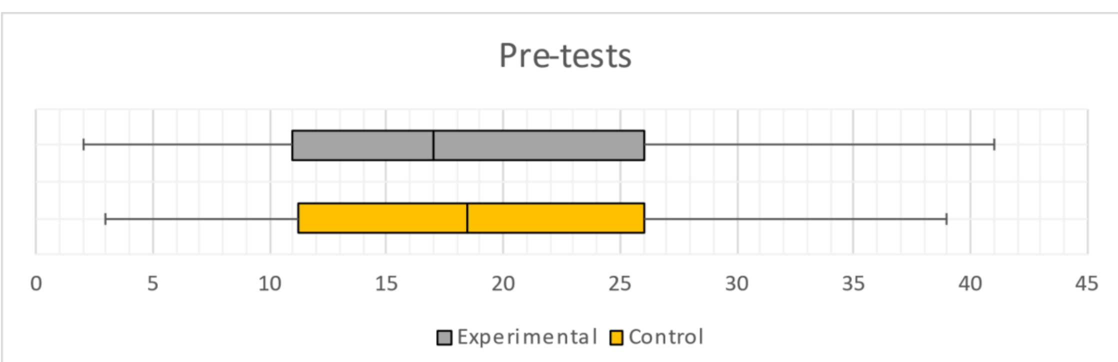

Figure 4.3. The box plot of the pre-test scores for the control group and the experimental group

Figure 4.3. above indicates that three quarters of the learners in the control group and the experimental group scored less than 26 (the upper quartile), which is 52% in the pre-test. Half of the control group scored less than 18.5 (the median) while half of the experimental group scored below 17. The t-test was then calculated to test whether, statistically, a significant difference existed between the two groups. Table 4.4 shows the results of the Mathematics pre-test for both experimental and control groups.

Table 4.4: Results of the experimental group pre-test and control group pre-test

	Experimental group	**Control group**
Number of participants (N)	40	40
Mean	19.25	18.7
Variance	120	80.4
Standard deviation (SD)	11.0	8.97
$t_{calculated}$		0.807
$t_{critical}$		2.000

The Mathematics pre-test results displayed the experimental group mean score of 19.25 and the control group mean score of 18.7. This indicates that there was a slight difference of 0.55 in the Mathematics pre-test mean scores of the experimental group and control group. The t-test for the Mathematics pre-test outcomes with the degree of freedom, (df) = 78 at the significance level, α = 0.05 yielded $t_{calculated} = 1.09$, and the statistical table value of $t_{critical}$ = 2.000, for two tailed tests. This indicates that the $t_{calculated}$ is less than $t_{critical}$ which shows that statistically, there was no significant difference between the performance of the control group and the experimental group in the pre-test. This suggests that both the experimental and control groups had comparable prior knowledge of Algebraic Expressions, hence the participants in both groups could be said to have been equivalent at the beginning of the intervention.

4.3.2 Comparisons of the control group pre-test and post-test

After the learners wrote the pre-test, the control group was taught Algebraic Expressions, based on objectives on the topic as stipulated in the Mathematics NSSCO syllabus. Intervention lasted for two weeks, whereby participants were instructed using the traditional teaching methods, the teacher explained and worked on a few examples/questions on the board. The teacher highlighted the importance of attentive listening and note-taking to the learners. The Mathematics post-test was then administered after intervention. The scores of the control group pre-test and control group post-test were compared to identify any differences using a box and whisker plot. Figure 4.4. below gives the comparison of how the scores in pre-test and post-test of the control group were spread.

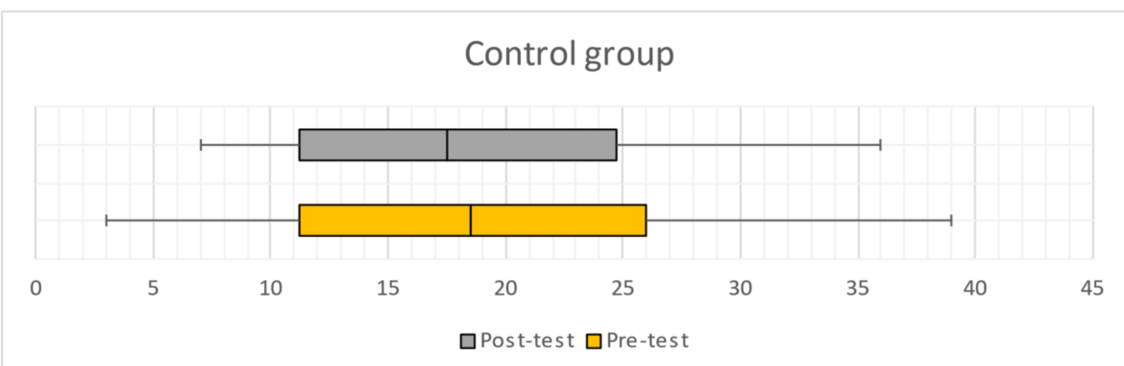

Figure 4.4. Box plot illustrating the pre-test and post-test distributions of the control group.

The box and whisker plot shows that 50% of the control group scored below 18.5 (the median value) which is 37% in the pre-test. In the post-test, 50% of the learners scored below 17.5 (the median value) which is 35%. The Mathematics pre-test results for the control group and post-test results for the control group were compared utilizing the t-test and mean scores (refer to Table 4.5).

Table 4.5: Results of the control group pre-test and post-test

	Pre-test	**Post-test**
Number of participants (N)	40	40
Mean	18.7	19.05
Variance	80.4	73.1
Standard deviation (SD)	8.97	8.55
$t_{calculated}$		0.503
$t_{critical}$		2.000

Table 4.5 shows that Mathematics pre-test results for the control group yielded a mean score of 18.7 and Mathematics post-test mean score was 19.05. This indicates that there was a slight difference of 0.35 which could mean that the learners grasped a little content from the intervention. The t-test yielded $t_{calculated} = 0.503$ at α = 0.05 and degree of freedom, (df) = 78, and the statistical table value of $t_{critical}$ = 2.000, for two tailed tests. This clearly indicates that the $t_{calculated}$ is less than $t_{critical}$ which shows that statistically,

there was no significant difference between the control group pre-test scores and control group post-test scores. This shows that the control group learners had similar performance in both the two tests, pre-test and the post-test.

4.3.3 Experimental group – pre-test versus post-test

After the pre-test was administered, the experimental group was taught the same topic content as the control group, utilising Activity-Based Instruction method, where the teacher worked on many examples and the learners were provided with activities to work on and practice during lessons and during their free time (see Appendix M). The intervention lasted for two weeks and after intervention a post-test was given to the learners. The pre-test scores and the post-test scores for the experimental group were compared to identify any differences. The box and whisker plot in figure 4.5. below gives the comparison of how the scores in the pre-test and post-test of the experimental group spread.

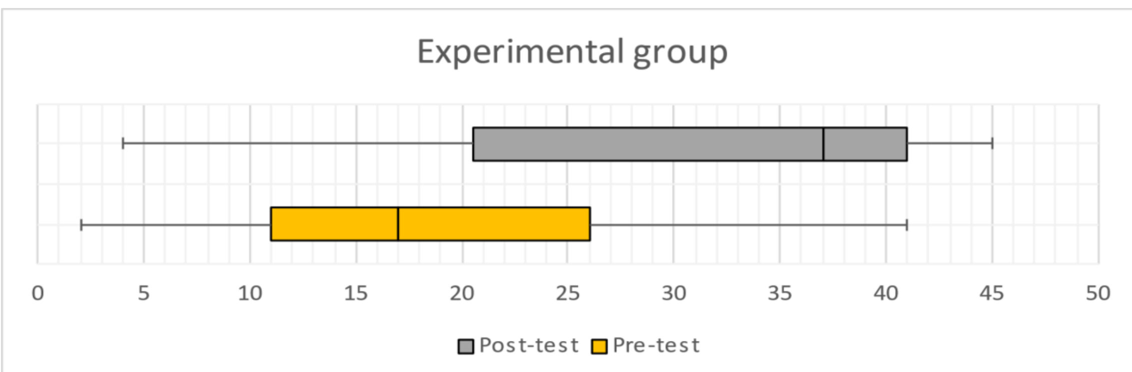

Figure 4.5. Box plot illustrating the pre-test and post-test distribution of the experimental group

The median post-test score of 37 exceeds the median pre-test score of 17. Half of the experimental group managed to score above 37 (the median value) which is 74% in the post-test while in the pre-test half the learners scored below 17 which is 34%. The experimental group's mean scores for the pretest and the post-test were compared utilizing the t-test, as shown in Table 4.6 below.

Table 4.6: Results of the experimental group pre-test and post-test

	Pre-test	**Post-test**
Number of participants (N)	40	40
Mean	19.25	31.55
Variance	120	142
Standard deviation (SD)	11.0	11.9
$t_{calculated}$		2.60
$t_{critical}$		2.000

Table 4.6 shows that Mathematics pre-test results for experimental groups produced a mean score of 19.25 while Mathematics post-test results for experimental groups produced a mean score of 31.55. This indicates that there was a difference of 12.3 between the two means. This could mean that the learners grasped much content from the intervention. The t-test yielded $t_{calculated} = 2.60$ at α = 0.05 and degree of freedom (df) = 78, and the statistical table value of $t_{critical}$ = 2.000, for two tailed tests. This clearly indicates that the $t_{calculated}$ is greater than $t_{critical}$ which indicates that statistically, a significant difference existed between the pre-test scores and post-test scores for the experimental group. This could mean that the method of instruction used, Activity-Based Instruction, enhanced the performance of the learners in Algebraic Expressions after intervention.

4.3.4 Comparison of the experimental group post-test and control group post-test

A box and whisker plot was utilized to give a comparison between the control group scores and the experimental group scores in the post-test.

Figure 4.6. Box plot illustrating the post-tests scores of the control group and experimental group

Half of the control group scored below 17.5 (the median) which is 35%, below three quarters of the experimental group that scored less than 21.5 (the lower quartile) which is 43%. The experimental group's median score (37) is not in the same box as the control group, suggesting a potential difference between the experimental group and the control group. The following hypotheses were evaluated to determine the impact of Activity-Based Instruction on the performance of the Grade 11 learners and identify any statistically significant differences.

H_0: There is no significant difference in the Grade 11 Mathematics learners' performance in Algebraic Expressions between those who are taught utilizing Activity-Based Instruction and those who are taught utilizing the traditional method only.

H1: There is a significant difference in the Grade 11 Mathematics learners' performance in Algebraic Expressions between those who are taught utilizing Activity-Based Instruction and those who are taught utilizing the traditional method only.

Table 4.7 shows the t-test findings and post-test mean scores for both the control and experimental groups.

Table 4.7: The t-test results of the post-tests for the experimental group and control group

	Experimental group	Control group
Number of participants (N)	40	40
Mean	31.55	19.05
Variance	142	73.1
Standard deviation (SD)	11.9	8.55
$t_{calculated}$		8.77
$t_{critical}$		2.000

According to Table 4.7, the mean score of the post-test for experimental group is 31.55, while the mean score of the post-test for the control group is 19.05. This indicates that the experimental and control groups had a mean score difference of 12.5 in the post-test. The $t_{calculated} = 8.77$ at α = 0.05 and degree of freedom (df) = 78, and the statistical table value of $t_{critical}$ = 2.000, for two tailed tests. This clearly indicates that the $t_{calculated}$ is greater than $t_{critical}$ which means that statistically, there is a significant difference between the Mathematics experimental group post-test scores and Mathematics control group post-test scores. Hence, the study rejects H_0 and concludes that Grade 11 Mathematics learners do much better in Algebraic Expressions when taught via Activity-Based Instruction compared to traditional methods.

4.3.5 Discussion of finding from quantitative data

This section discusses the findings of the chapter on the impact of Activity-Based Instruction on Grade 11 learners' Algebraic Expressions performance. It also provides the comparison of the performance of the learners in the pre-test and post-test.

4.3.5.1 The effects of Activity-Based Instruction on the performance of the Grade 11 learners in Algebraic Expressions

The pre-test scores of the experimental group and the control group show that there was no statistically significant difference between the experimental group and the control group as indicated in Table 4.4. For two tailed tests, $t_{calculated} = 0.807$ and at α = 0.05, $t_{critical}$ = 2.000. These results indicate that statistically, there is no significant difference between the pre-test for the control group and the post-test for the control group. The mean score of the pre-test experimental group is not that far from the mean score of the pre-test control group, indicating that the two groups were of the equivalent level of understanding in Mathematics before intervention.

On the other hand, following intervention the experimental group outperformed the control group, in the post-test, where $t_{calculated} = 8.77$ is greater than $t_{critical}$ = 2.000, as shown in Table 4.7, and statistically, at α = 0.05, there was a significant difference between the experimental group pre-test and experimental group post-test. The null hypothesis, H_0 was rejected and it was concluded that there existed a significant difference in the mean scores for post-test for the experimental group and the control group on the topic, Algebraic Expressions.

Based on the findings reported in Table 4.7, Activity-Based Instruction have a positive influence on the performance of grade 11 learners in Algebraic Expressions. The table shows that there were differences between the experimental group and control group in terms of pre-test and the post-test mean scores, where the post-test for the control group has a mean score of 19.05 and the post-test for the experimental group has a mean score of 31.55, which is above that of the control group. This indicates that in the post test, the experimental group significantly outperformed the control group. This significant difference in the experimental group concurs with findings from previous studies (Albadi & David, 2019; Pokhrel, 2018; Luitel, 2019 & Çelik, 2018) that Activity-Based Instruction improves the academic achievement of the learners in as compared to traditional methods in Algebraic Expressions, thus it has a positive impact on the performance of the learners in Algebraic Expressions.

The involvement of the learners in the lesson by attempting a lot of activities with each other, and also the teacher working out or solving problems with the learners could be some of the possible reasons for the significant difference. The results of this study suggest a positive impact of Activity-Based Instruction on the Grade 11 learners' performance in Algebraic Expressions in comparison to traditional teaching methods only. Thus, teachers need to shift from traditional teaching pedagogies to effective teaching pedagogies such as Activity-Based Instruction (Festus, 2013; Luitel, 2019).

4.3.5.2 The comparisons of the performance of the learners in the pre-test and the post-test

The pre-test and post-test for the control group were compared in Table 4.5. It was shown that $t_{calculated} = 0.503$ is less than $t_{critical}$ = 2.000, which indicates that statistically, at α = 0.05 and degree of freedom(df) = 78, there was no significant difference in the control group pre-test and control group post-test. The mean scores for the pre-test and post-test were 18.7 and 19.05 respectively. This demonstrates that a slight difference of 0.35 in the mean scores existed, which was not statistically significant. These results concur with findings of a previous study (Luitel, 2019) that traditional teaching methods creates a negative perception towards Mathematics and hinders students' comprehension of the lessons. This could also mean that, since only the traditional method was used, the learners were limited to copying from the board, hindering their ability to process information properly, which leads to the learners losing interest in learning (Noreen & Rana, 2019). The difference in mean scores between the pre-test and post-test for the control group could be attributed to learners' motivation to work hard by being assigned to write the pre-test.

Table 6 presents the outcomes of the pre- and post-tests for the experimental group. The mean scores for the pre-test and the post-test are 19.25 and 31.55, respectively. The post-test mean score for the experimental group, 31.55, was greater than the mean score of the experimental group pre-test, 19.25, resulting in a mean difference of 12.3. The pre- and post-tests mean scores for the experimental group differed far from the average scores in the pre- and post-test for the control group. This indicates that Activity-Based Instruction has a positive influence on the learners' performance. Table 4 shows that $t_{calculated} =$

2.60 was greater than $t_{critical}$ = 2.000, and statistically, at α = 0.05 and degree of freedom(df) = 78, a significant difference existed between the experimental group pre-test and experimental group post-test results. This could be because the learners were exposed to different types of hands-on activities and were learning by doing was emphasized, and this could have increased their interest in Mathematics (Oribhabor, 2020).

This could mean that the intervention given to the experimental group, Activity-Based Instruction, which involved a lot of hands-on activities improved the learners' performance as compared to the traditional methods which were utilised to teach the control group. These results concur with the previous study (Çelik, 2018), which found that using Activity-Based Instruction to teach Mathematics has been revealed as an instructional method that improves students' academic performance and attitudes towards activities compared to traditional education methods. It is therefore significant that traditional methods need to be supplemented by a lot of hands-on activities to improve the performance of learners in Mathematics.

4.4 PRESENTATION OF QUALITATIVE DATA

The qualitative data collected are presented using a frequency table, textual descriptions under relevant themes and sub-themes in this section. This section begins with the presentation of teachers' reflections on the utilisation of Activity-Based Instruction in Mathematics. The section lastly presents teachers' suggestions on how the Directorate of Education can support them in implementing Activity-Based Instruction.

4.4.1 Activity-Based Instruction in teaching Mathematics

The findings on the views of teachers of Mathematics on the utilisation of Activity-Based Instruction in teaching Mathematics are analysed. A five-point Likert rating scale was used, which consisted of Strongly agree, Agree, Neutral, Disagree and Strongly disagree. Table 4.8 shows the participating Mathematics teachers' responses on the 12 statements that required the Mathematics teachers to indicate their level of agreement.

Table 4.8: Teachers views on the use of Activity-Based Instruction in the teaching of Mathematics

Statement	Strongly agree	Agree	Neutral	Disagree	Strongly disagree	Total
	Frequency	Frequency	Frequency	Frequency	Frequency	
1. I find it difficult to manage time effectively during ABI sessions.	0	4	2	2	0	8
2. My students are more engaged when I use ABI compared to traditional teaching methods.	5	3	0	0	0	8

3. I feel confident in my ability to design and implement ABI activities.	3	4	1	0	0	8
4. I have adequate resources (e.g., materials, tools) to conduct ABI in my classroom.	0	3	5	0	0	8
5. Classroom management is more challenging during ABI compared to traditional instruction.	0	2	3	3	0	8
6. I received sufficient training and professional development on ABI techniques.	0	3	2	3	0	8
7. The curriculum allows flexibility for integrating ABI in my teaching.	0	6	2	0	0	8
8. My students' performance improves with ABI.	1	6	0	1	0	8
9. Assessment of student learning is more complex with ABI.	0	3	3	1	1	8

10. ABI accommodates the diverse learning needs of my students.	0	7	1	0	0	8
11. I have sufficient time to plan and prepare for ABI activities.	1	3	2	2	0	8
12. Technical issues (e.g., lack of technology, internet problems) hinder the implementation of ABI.	3	3	2	0	0	8

4.4.2 Engagement of learners when Activity-Based Instruction is being used as compared to traditional teaching methods

Table 4.8 shows that all the eight Mathematics teachers agree with the statement: *My students are more engaged when I use ABI compared to traditional teaching methods*, with five teachers who strongly agreed and three teachers who agreed.

Despite the learners' being more engaged when Activity-Based Instruction is being used in teaching Mathematics, the answers to statement 6 in Table 4.8 shows that three teachers indicated that they did not receive sufficient training and professional development on Activity-Based Instruction techniques, although three of the other teachers agreed with the statement. Two of the mathematics teachers indicated that:

Teacher B: *To effectively implement Activity-Based Instruction, teachers must be trained on how to set activities that accommodate learners with different learning styles.*

Teacher H: *To effectively implement Activity-Based Instruction, educators must be made aware of the importance of Activity-Based Instruction and that it must be taken as a teaching method. Educators must be trained on how to carry it out and when to carry it out during the lesson. Educators must also be trained on how to come up with activities.*

4.4.3 Benefits of Activity-Based Instruction on the learners' performance

In Table 4.8, it is indicated that seven out of the eight Mathematics teachers agree with statement 8: *My students' performance improves with ABI*. This result goes in line with the findings by Çelik (2018) who concluded that implementing Activity-Based Instruction in the Mathematics curriculum enhances students' academic performance and success.

In addition, Table 4.8 also shows that seven out of the eight Mathematics teachers are in agreement with the statement: *ABI accommodates the diverse learning needs of my students*, while one of the Mathematics teachers is neutral about this. Four of the Mathematics teachers said the following on how they address diverse learning needs during ABI session:

Teacher B: *Give questions at different levels of understanding.*

Teacher C: *Allow each learner to do on their own to check progress and correct them individually.*

Teacher G: *Make sure that all the learners are engaged during the lesson.*

Teacher H: *Group learners, give feedback on time, encourage all learners to participate by writing in papers and exchange with each other for marking, and slow learners must be addressed first or they must be the centre of attention.*

MoEAC (2016) supports learner-centred education, which emphasised that learners learn the most when they are involved actively in the learning process via active engagement, contribution, and creation.

4.4.4 Challenges experienced when implementing Activity-Based Instruction

Table 4.8 shows that four of the Mathematics teachers agree with statement 1*: I find it difficult to manage time effectively during ABI sessions,* while two Mathematics teachers disagree with the statement and the other two teachers are neutral. Table 4.8 also shows that three teachers are in agreement with the statement: *I have adequate resources (e.g., materials, tools) to conduct ABI in my classroom,* while five of the Mathematics teachers are neutral. Table 4.8 also shows that six of the Mathematics teachers agree with the statement: *Technical issues (e.g., lack of technology, internet problems) hinder the implementation of ABI,* while two of them are neutral. In addition, three of the Mathematics teachers indicated the following as challenges they face when implementing Activity-Based Instruction in Mathematics classroom:

Teacher E: *Insufficient time to help out each learner,* as one of the challenges experienced while implementing Activity-Based Instruction in Mathematics classroom.

Teacher F: *Time for marking and providing feedback within the lesson is always not enough.*

Teacher H: *Time management, not enough time to plan and insufficient teaching and learning materials to be used.*

Despite the challenges, seven out of the eight Mathematics teachers are in agreement with the statement: *I feel confident in my ability to design and implement ABI activities*, with three of the teachers who strongly agree and four of them agree; while one of them is neutral about their confidence. In addition to this, six out of the eight Mathematics teachers are in agreement with the statement: *The curriculum allows flexibility for integrating ABI in my teaching*, while two of the Mathematics teachers are neutral about this statement.

On the other hand, two of the Mathematics teachers suggested the following, on the types of resources or support that would help you overcome the challenges associated with ABI:

Teacher E: *Giving extra lessons after school just to help out all the learners.*

Teacher H: *Lesson time to be prolonged, integration of technology in school, e.g., setting questions in a video projected on the wall, and Activity-Based Instruction must be included in the syllabus.*

4.4.5 Teachers' view on how the Directorate of Education can support teachers in implementing Activity-Based Instruction

Teacher B: *Workshop should include Activity-Based Instruction implementation.*

Teacher E: *Create posts for tutors in schools*.

Teacher H: *By allowing Activity-Based Instruction to be part of the syllabus, to be made a "must thing" to be done during teaching and learning.*

4.4.6 Discussion of findings from qualitative data

This section delves into the analysis of qualitative data. It begins with a description of Activity-Based Instruction for teaching Mathematics. Lastly it discusses the teachers' views on how the Directorate of Education can support teachers in implementing Activity-Based Instruction.

4.4.6.1 Activity-Based Instruction in teaching Mathematics

The study sought to determine the impact of Activity-Based Instruction as a method of instruction. The findings discussed in this subsection were obtained from eight Mathematics teachers via questionnaires and sought to provide answers to the study's two research questions:

1 What are the effects of Activity-Based Instruction on the learners' performance in Algebraic Expressions?

2 What are the challenges experienced by Mathematics teachers when integrating Activity-Based Instruction?

4.4.6.2 Engagement of learners when Activity-Based Instruction is being used as compared to traditional teaching methods

Activity-Based Instruction actively engages learners in the mathematics lessons as compared to traditional teaching methods. These results agree with the views of Oribhabor (2020) who described Activity-Based Instruction as an instructional approach which focusses on active learning through activities and hands-on experiences, encouraging students to engage in the lesson and learn by doing. It is thus recommended that teachers understand the significance of Activity-Based Instruction and must be trained on how to carry it out and when to carry it out during the lesson.

Despite the learners' being more engaged when Activity-Based Instruction is being used, some teachers did not receive sufficient training on Activity-Based Instruction techniques. Thus, it is suggested that teachers must be given enough training on how to set up activities that accommodate learners with different learning styles.

4.4.6.3 Benefits of Activity-Based Instruction on the learners' performance

Learners' performance seems to improve with Activity-Based Instruction. This result goes in line with findings by Çelik (2018) who concluded that implementing Activity-Based Instruction in the Mathematics curriculum has been shown to enhance students' academic performance and success. Activity-Based Instruction appears to meet the different demands of learners, whereby it allows teachers to provide learners with questions at different levels of understanding, allow learners to do their own work to check their progress and correct them individually and give feedback on time. These results agree with Albadi and David (2019) who note that activity-based method of instruction improves knowledge by strengthening long-term learning through direct experience, and this is further attributed to students' role in aiding one another during the learning process.

4.4.6.4 Challenges experienced when implementing Activity-Based Instruction

Managing time effectively or insufficient time during Activity-Based Instruction sessions, lack of adequate resources (e.g., material, tools) and technical issues (e.g., lack of technology, internet problems) were found to be challenges that seem to hinder the integration of Activity-Based Instruction in teaching Mathematics. These results agree with the findings by Çelik (2018) who found that packed classes, limited time, insufficient materials, and poor facilities are some of the factors that challenge the integration of Activity-Based Instruction. It was thus suggested that time allocated to Mathematics lessons could be made longer to accommodate the integration of Activity-Based Instruction.

4.4.6.5 Teachers' view on how the Directorate of Education can support teachers in implementing Activity-Based Instruction

Mathematics teachers seem to believe that workshops for Mathematics that include training on the integration of Activity-Based Instruction in teaching Mathematics and allowing Activity-Based Instruction to be part of the syllabus might assist and support teachers in implementing Activity-Based Instruction in teaching Mathematics. Teachers also suggested that posts for Mathematics tutors need to be created in school.

4.5 Summary

This section summarized quantitative data acquired from pre-tests and post-tests for both experimental group and control group in the study. The mean scores, degree of freedom, t-calculated and standard deviation were calculated, and values were summarised and presented in tables. The results were compared, which allowed the researcher to determine whether the differences that exist between the experimental and control group are statistically significant. The section also summarized qualitative data collected from the views of teachers for Mathematics on the impact of Activity-Based Instruction on the

Grade 11 learners' performance in Algebraic Expressions, in Onankali Circuit of Oshikoto Region.

The quantitative findings of the study exposed that utilising Activity-Based Instruction to teach Mathematics has a positive influence on the learners' performance. The findings of this study specify that statistically, there was no significant difference in the experimental group pre-test and control group pre-test. This could indicate that the two groups had similar levels of mathematical understanding before intervention. After intervention, the mean score for the experimental group was higher than the mean score for the control group, statistically resulting in a significant difference between the post-test for the experimental group and post-test for the control group. The results of the study seemed to suggest that the integration of Activity-Based Instructional method in the teaching of Mathematics; Algebraic Expressions improved learners' performance in the topic, hence it could be concluded that the use of hands-on activities has a positive impact on the performance achievement of the learners in Algebraic Expressions.

This study found that the incorporation of Activity-Based Instruction in teaching Mathematics appears to have a positive impact on the performance of learners. Students seem to be more engaged when Activity-Based Instruction is being used than when the traditional teaching methods are being utilised. It is also believed that Activity-Based Instruction seems to accommodate the diverse learning needs of students. It also emerged that some Mathematics teachers seem to have not received sufficient training and professional development on Activity-Based Instruction techniques. On the other hand, lack of time management during Activity-Based Instruction sessions or insufficient time to integrate Activity-Based Instruction in a Mathematics lesson, inadequate resources (e.g., materials, tools) to conduct Activity-Based Instruction in Mathematics classroom and technical issues (e.g., lack of technology, internet problems) seem to be some of the challenges that obstruct the integration of Activity-Based Instruction when teaching Mathematics.

CHAPTER 5: SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

This Chapter summarises the study's key findings, draws conclusions, and offers suggestions and recommendations for additional research.

5.1 Summary of the main findings

This study examined the impacts of Activity-Based Instruction on the performance of the Grade 11 learners in Algebraic Expressions: a case of Onankali Circuit in Oshikoto Region. The study aimed at finding answers to the following two questions:

1. What are the effects of Activity-Based Instruction on the Grade 11 learners' performance in Algebraic Expressions?
2. What are the challenges experienced by Mathematics teachers when integrating Activity-Based Instruction?

The following hypotheses were tested at the significant level of $\alpha = 0.05$:

H_0: There is no significant difference in the Grade 11 Mathematics learners' performance in Algebraic Expressions between those who are taught utilising Activity-Based Instruction and those who are taught utilising the traditional method only.

H_1: There is a significant difference in the Grade 11 Mathematics learners' performance in Algebraic Expressions between those who are taught utilising Activity-Based Instruction and those who are taught utilising the traditional method only.

The researcher employed a mixed-method design, utilising non-equivalent pre-test-post-test quasi-experimental design and a survey. The study consisted of 80 Grade 11 Mathematics learners from two schools in Onankali Circuit in Oshikoto Region and eight senior secondary Mathematics teachers in Onankali Circuit. The schools were conveniently selected and two classes, one from each school, with 40 learners, were randomly selected to form the experimental group and the control group. The Mathematics pre-test and post-test on Algebraic Expressions were used to investigate the impacts of Activity-Based Instruction on the learners' performance in Algebraic Expressions. A pre-test on Algebraic Expressions was administered to all the 80 learners before intervention.

After the pre-test was written, the two groups were separately taught the same topic for two weeks. The experimental group was taught utilising Activity-Based Instruction while the control group was taught utilising the traditional method. After the intervention, a post-test was given.

A total of eight senior secondary Mathematics teachers in Onankali Circuit took part in the study by completing the questionnaire that was administered to them. The questionnaire was on the Mathematics teachers' views on the use of Activity-Based Instruction. The data from the questionnaire were analysed using a frequency table and textual descriptions.

For ethical considerations, all participants were fully informed of the purpose and objectives of the study. It was made clear to the participants that they could withdraw from the research study at any moment, and that the information they gave, which was utilized solely for the purpose of the study, was kept personal and anonymous.

The experimental group achieved a higher mean post-test score of 31.55 than the control group's score of 19.05, indicating that statistically, there was a significant difference at $\alpha = 0.05$, in the experimental group post-test and control group post-test. The implementation of Activity-Based Instruction in teaching the experimental group resulted in a high mean score difference. Findings of the study also indicated that senior secondary teachers for Mathematics felt that students are more engaged when Activity-Based Instruction is being used as compared to traditional teaching methods, although one of the Mathematics teachers suggested that it must be tested first for effectiveness. Seven out of the eight Mathematics teachers that participated in the study believe that students' performance is enhanced with Activity-Based Instruction and also believe that Activity-Based Instruction accommodates the diverse learning needs of students. It also emerged that some Mathematics teachers did not receive sufficient training and professional development on Activity-Based Instruction techniques. Senior secondary Mathematics teachers experience various challenges when they integrate Activity-Based Instruction in teaching Mathematics. These challenges, amongst others, include lack of time management during Activity-Based Instruction sessions or insufficient time to integrate Activity-Based Instruction in a Mathematics lesson, inadequate resources (e.g., materials, tools) to conduct Activity-Based Instruction in Mathematics classroom and technical issues (e.g., lack of technology, internet problems).

5.2 Conclusions

This study examined the impacts of Activity-Based Instruction on the performance of the Grade 11 learners in Algebraic Expressions: a case of Onankali Circuit in Oshikoto Region. The pre-test mean scores for the experimental and control groups were 19.25 and 18.7, respectively, whereas the experimental group's and the control group's post-test mean scores were 31.55 and 19.05, respectively. The use of Activity-Based Instruction in teaching Mathematics seemed to have improved the learners' performance in Algebraic Expressions. The findings of the study provided evidence on the effectiveness of hands-on activities in the teaching of Mathematics and suggested that Activity-Based Instruction has a positive influence on learners' performance in Algebraic Expressions. Senior secondary Mathematics teachers experience various challenges upon integrating Activity-Based Instruction in teaching Mathematics such as insufficient time, inadequate resources and technical issues.

5.3 Recommendations

This study examined the impacts of Activity-Based Instruction on the performance of the Grade 11 learners in Algebraic Expressions. The analysis of the data pointed to certain impact of utilising Activity-Based Instruction when teaching Mathematics. Therefore, the following recommendations are made based on the finding of the research study:

1. Mathematics teachers should be encouraged to come up with hands-on activities and use them during their Mathematics lessons.
2. The Ministry of Education, Arts and Culture should design a Continuous Assessment form for Mathematics Grades 10 -11, so that learners are assessed in every topic.

Suggestions for further research

1. Further research should be conducted to explore the factors that hinder the use of Activity-Based Instruction when teaching Mathematics.
2. Further research should be conducted to investigate the teachers' perceptions towards Activity-Instruction in the teaching of Mathematics.

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APPENDICES

APPENDIX A: THE ETHICAL CLEARANCE CERTIFICATE

UNAM

UNIVERSITY OF NAMIBIA

ETHICAL CLEARANCE CERTIFICATE

Ethical Clearance Reference Number: DEC: HPC00018   Date: 21 August 21, 2023

This Ethical Clearance Certificate is issued by the University of Namibia Ethics Committee (REC) in accordance with the University of Namibia's Research Ethics Policy and Guidelines. Ethical approval is given in respect of undertakings contained in the Research Project outlined below. This Certificate is issued on the recommendations of the ethical evaluation done by the ethics committee.

Title of Project: The Impacts of Activity-Based Instruction On Grade 11 Learners' Performance in Algebraic Expressions: A Case of Onankali Circuit, Oshikoto Region

Student: **KLAUDIA SHILAMBA**
Student Number: **201403539**

Supervisor(s): DR ELAGO

Centre for Research Services
Take note of the following:

1. Any significant changes in the conditions or undertakings outlined in the approved Proposal must be communicated to the ethics committee. An application to make amendments may be necessary.
1. Any breaches of ethical undertakings or practices that have an impact on ethical conduct of the research must be reported to the ethics committee.
2. The Principal Researcher must report issues of ethical compliance to the ethics committee (through the Chairperson) at the end of the Project or as may be requested by the ethics committee.
3. The ethics committee retains the right to:

i) Withdraw or amend this Ethical Clearance if any unethical practices (as outlined in the Research Ethics Policy) have been detected or suspected,

i) Request for an ethical compliance report at any point during the research.

The ethics committee wishes you the best in your research.

Dr Anfjelina Popyeni Amushigamo (Chairperson DEC HPC)

Prof. Davis Mumbengegwi (Head, Multidisciplinary Research)

APPENDIX B: PERMISSION LETTER FROM THE REGIONAL DIRECTOR OF EDUCATION

REPUBLIC OF NAMIBIA

OSHIKOTO REGIONAL COUNCIL

Tel: (065) 242500 **DIRECTORATE: EDUCATION, ARTS & CULTURE** Private Bag 2028
Fax: (065) 240315 ONDANGWA
Enquiries: Ms Tende 01 September 2023

Ref: 13/2/9/1

Ms Klaudia N Shilamba
PO Box 3815
Ongwediva
Email: claudyvaxido@gmail.com

Dear Ms Shilamba

RE: PERMISSION TO CONDUCT A RESEARCH STUDY AT A SELECTED SCHOOL IN OSHIKOTO REGION

The Office of the Director acknowledges receipt of your letter seeking for permission to conduct a research study focusing on "*Impacts of activity-based instruction on grade 11 learners' performance in Algebraic expressions*". A case study of a selected school in Onankali Circuit.

Kindly be informed that permission has been granted to carry out the research in Oshikoto Region, please be guided by the following:

- You have to consult the school principal well in advance to ensure a proper co-ordination of other school activities
- The research should not interfere with the normal teaching and learning process at the school.
- Participation in the research should be on a voluntary basis.
- The information to be collected should be treated as confidential and only for research purposes.

Thank you for showing interest to do the research in the Oshikoto Region. It is our sincere hope that the information you would gather will be useful towards the completion of your qualification.

Sincerely yours

OSHIKOTO REGIONAL COUNCIL
Director
2023 -09- 01
PRIVATE BAG 2028
ONDANGWA

MS ALETTA A. EISES
DIRECTOR OF EDUCATION, ARTS AND CULTURE
OSHIKOTO REGION

APPENDIX C: LETTER TO THE DIRECTOR OF EDUCATION, OSHIKOTO REGION

Enq: Ms. K.N. Shilamba
Cell: +264 814871772
Email: claudyvaxido@gmail.com

P.O.Box 3815,
Ongwediva

30 August 2023

The Director of Education

Oshikoto Education Region

Private Bag 2028

Ondangwa

Dear Madam

Re: Request for permission to conduct research at a selected school in Oshikoto region

I am Klaudia N. Shilamba, a Masters of Education student in the field of Mathematics Education at the University of Namibia. To fulfil the requirements for the degree of Masters of Education, I am required to conduct research. My research is on the topic **"Impacts of activity-based instruction on grade 11 learners' performance in algebraic expressions: a case of Onankali circuit, Oshikoto region".** This study aims to investigate the impacts of activity-based instruction on grade 11 learners' performance in algebraic expressions as a teaching strategy to improve learners' performance in mathematics, particularly in algebraic expressions. The research is planned to be carried at selected schools in Oshikoto region from 31 August 2023 to 8 September 2023.

This study will comprise of 80 Grade 11 learners that are doing Mathematics from a selected school. Cluster random sampling will be used to select the sample of participating classes. A class consisting of 40 learners will serve as an experimental group and the learners will be taught using Activity-Based Instruction while another class of 40 learners will serve as a control group and the learners will be taught using the lecture method, which in total makes up 80 learners. A pre-test will be administered to both groups of selected learners to participate in the study before intervention. The researcher will teach the topic, Algebraic expressions using two different methods. A post-test will then be administered after intervention to test the impact of the teaching strategies.

I therefore kindly request your good office to allow me to conduct this vital research in Oshikoto as my research site. It is my hope that the study will generate useful data which will be valuable to different stakeholders in mathematics education. In this regard, participants will be asked to sign consent forms and those younger than 16 years, their parents will be required to sign a consent letter for them.

Attached please find ethical clearance letter from the University of Namibia.

Thank you in advance for the anticipated favorable response.

Yours sincerely

Klaudia N. Shilamba

University of Namibia

APPENDIX D: LETTER TO THE SCHOOLS PRINCIPALS

Enq: Ms. K.N. Shilamba

Cell: +264 814871772

Email: claudyvaxido@gmail.com

P.O. Box 3815,

Ongwediva

01 September 2023

The School Principal

…………………………….School

P.O.Box ………………

Omuntele

Dear Sir/Madam

Re: Request for permission to conduct research at …………………………… School

I am Klaudia N. Shilamba, a Masters of Education student in the field of Mathematics Education at the University of Namibia. To fulfil the requirements for the degree of Masters of Education, I am required to conduct research. My research is on the topic **"Impacts of activity-based instruction on grade 11 learners' performance in algebraic expressions: a case of Onankali circuit, Oshikoto region".** This study aims to investigate the impacts of activity-based instruction on grade 11 learners' performance in algebraic expressions as a teaching strategy to improve learners' performance in mathematics, particularly in algebraic expressions. The research is planned to be carried at selected schools in Oshikoto region from 05 September 2023 to 22 September 2023.

This study will comprise of 80 Grade 11 learners that are doing Mathematics from selected schools. Cluster random sampling will be used to select the sample of participating classes. A class consisting of 40 learners will serve as an experimental group and the learners will be taught using Activity-Based Instruction while another class of 40 learners will serve as a control group and the learners will be taught using the lecture method, which in total makes up 80 learners. A pre-test will be administered to both groups of, 40 each, selected learners to participate in the study before intervention. The researcher will teach the topic, Algebraic expressions using two different methods and lessons will be conducted in the evening between 18h00-20h00. A post-test will then be administered after intervention to test the impact and effectiveness of the teaching strategies.

I therefore kindly request your good office to allow me to conduct this vital research at your school. It is my hope that the study will generate useful data which will be valuable to different stakeholders in mathematics education. In this regard, participants will be asked to sign consent forms and those younger than 16 years, their parents will be required to sign a consent letter for them. To assure anonymity, the participants will be given pseudo names to safeguard their identities. A timetable for lessons with dates and time will be provided, and will not interrupt the normal class teaching time.

Attached please find the ethical clearance certificate from the University of Namibia and, the permission letter to conduct research in Oshikoto Region granted by the office of the Oshikoto Regional Director of Education.

Thank you in advance for the anticipated favorable response.

Yours sincerely

Klaudia N. Shilamba

University of Namibia

APPENDIX E: CONSENT FORM FOR TEACHERS

Dear participants

You are invited to participate in a research study aimed at investigating "**The impacts of activity-based instruction on grade 11 learners' performance in algebraic expressions: a case of Onankali circuit, Oshikoto region**".

The study will be conducted towards the attaining of a Masters of Education (Mathematics Education). Furthermore, the study will make appropriate recommendations for teaching and learning Mathematics. Your feedback and input are therefore crucial to this the study.

Your information will be treated with utmost confidentiality and anonymity, and your name will not appear on the questionnaire. Your participation in this study is voluntarily.

If you are willing to participate in this study, please sign this letter as a declaration of your consent. Any information that will be obtained from the questionnaire will be used solely for the purpose of this research study.

Your Sincerely

Klaudia N. Shilamba

M.Ed. student

University of Namibia

Consent

I agree to participate in the research study titled **"The impacts of activity-based instruction on grade 11 learners' performance in algebraic expressions: a case of Onankali circuit, Oshikoto region"** as outlined in the consent letter.

Name: ……………………………………………………

Signature: ………………………………………………….

Date: ………………………………………………………….

APPENDIX F: CONSENT FORM FOR PARENTS/GUARDIANS

Enquiries: Ms. Klaudia N. Shilamba, Education Department

Cell: +26481 4871772

Email: claudyvaxido@gmail.com

University of Namibia

10 May 2023

Dear parent

INVITATION TO PARTICIPATE IN A STUDY

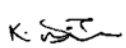
This communication is an invitation for you to grant your child permission to take part in this study. I am a full-time student pursuing a master's degree in education in the area of mathematics education at the University of Namibia, Windhoek campus. To fulfil the requirements for the degree of Masters of Education, I am currently conducting a research project, which aims to investigate the impacts of activity-based instruction on grade 11 learners' performance in algebraic expressions: a case of Onankali circuit, Oshikoto region. A pre-test will be administered to both groups of, 40 each, selected learners to participate in the study before intervention. The researcher will teach the topic, Algebraic expressions using two different methods. A class consisting of 40 learners will serve as an experimental group and the learners will be taught using Activity-Based Instruction while another class of 40 learners will serve as a control group and the learners will be taught using the lecture method, which in total makes up 80 learners. A post-test will then be administered after intervention to test the impact and effectiveness of the teaching strategies.

As a result, I am requesting your permission to allow your child to participate in this life-changing learning experience. Please fill and sign the accompanying declaration form to give your consent. Furthermore, please keep in mind that his/her participation in this study is voluntary, and the use of pseudonyms will ensure anonymity. Likewise, he/she reserves the right to withdraw from this study with no penalties. The study's findings will be published and presented in academic and professional settings. Please feel free to contact me at any time if you have any questions about this research**.**

Yours Sincerely

____

Klaudia N. Shilamba



M.Ed. student

University of Namibia

Declaration form

I____ (full names of the parent/guardian) thus acknowledge that I understand the contents of this paper and the nature of the educational intervention. As a result, I grant permission for my child ___________________________________ to participate in this research study.

____

____

Signature (parent/guardian) Date

APPENDIX G: CONSENT FORM FOR LEARNERS

Consent letter for learners

Topic: The impacts of activity-based instruction on grade 11 learners' performance in algebraic expressions: a case of Onankali circuit, Oshikoto region

I, ____ (name and surname) a grade 11 learner at Rev. Juuso Shikongo SS hereby give permission to be part of the above-mentioned research project. I am aware that my participation in this study remains voluntary and that I, at any time, may withdraw from the research without being penalized and I understand that all personal information will be treated as confidential by the researcher and data will be kept safe and only disposed after the completion of the study.

____

Name and signature

____

Date

Contact information:

Research supervisor: Dr. ERT Elago (0855719225)

Researcher: Ms. Klaudia N. Shilamba (0814871772)

APPENDIX H: TEACHERS' QUESTIONNAIRE

TEACHERS QUESTIONNAIRE

Participant pseudonym: ……………………………………….

I am Klaudia Shilamba, a student the University of Namibia enrolled for the Master of Education degree program. As part of my studies, I am conducting a survey on the "impact of Activity-Based Instruction on grade 11 learners' performance in algebraic expressions." I hereby request you to kindly help complete this survey. The information you provide will only be used for the purpose of this study.

For confidentiality and anonymity's sake, please DO NOT write your name anywhere on this form.

Kindly respond to ALL questions. The survey will take you about 7 minutes to complete.

SECTION A: Biographical information

Please mark with a cross **[X]** in the appropriate box.

1. Gender:

Male	
Female	
Other	

2. Age:

Under 25	
25 – 35	
36 – 45	
46 – 55	
56 +	

1. Years of teaching experience:

0 – 5	
6– 10	
11 -15	
16 – 20	
20 +	

2. Educational qualifications:

BETD	
B. Ed	
M. Ed	
Others (specify) …………………	

SECTION B: Activity-Based Instruction (ABI) in teaching Mathematics

Activity-Based Instruction is an instructional approach which emphasizes students' active learning through various activities and hands=on experiences, where students actively engage in the lesson rather than just sitting, listening and absorbing the lesson – it focuses on learning by doing (Oribhabor, 2020).

Please indicate your level of agreement with the following statements regarding Activity-Based Instruction (ABI) in Mathematics teaching. Mark with a cross **[X]** in the box of your choice.

.

Statement	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
1. I find it difficult to manage time effectively during ABI sessions.					
2. My students are more engaged when I use ABI compared to traditional teaching methods.					
3. I feel confident in my ability to design and implement ABI activities.					
4. I have adequate resources (e.g., materials, tools) to conduct ABI in my classroom.					

5. Classroom management is more challenging during ABI compared to traditional instruction.					
6. I received sufficient training and professional development on ABI techniques.					
7. The curriculum allows flexibility for integrating ABI in my teaching.					
8. My students' performance improves with ABI.					
9. Assessment of student learning is					

more complex with ABI.					
10. ABI accommodates the diverse learning needs of my students.					
11. I have sufficient time to plan and prepare for ABI activities.					
12. Technical issues (e.g., lack of technology, internet problems) hinder the implementation of ABI.					

SECTION C: Perspectives on Activity-Based Instruction

1. What challenges do you face when implementing Activity-Based Instruction in your Mathematics classroom?

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   …………………………………………………………………………………………

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2. What types of resources or support would help you overcome the challenges associated with ABI?

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3. How do you address diverse learning needs during ABI session?

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4. What additional training or professional development do you think is necessary for effectively implementing ABI?

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5. In your opinion, how can the directorate of education better support teachers in implementing ABI?

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6. Any other comments or suggestions related to ABI in Mathematics teaching?

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APPENDIX I: LEARNERS' PRE-TEST

MATHEMATICS PRE-TEST

TEST FOR PARTICIPANTS

Purpose: The purpose of this study is to investigate the impacts of activity-based instruction on the grade 11 learners' performance in algebraic expressions.

Direction: Please answer all the questions. Information provided and all research material collected will be in strictest confidence and will be used for research purpose only. Your response to this test highly appreciated.

Instructions:

- Write your pseudo name and school pseudo name on the space provided.
- Answer all questions on the space provided in this question paper.
- Show all your working clearly as this would earn you marks.
- This question paper consists of 5 pages including this page (information page).

Participant name (**e.g. A1**): ……………………………….……………………………

Participant School's name (**e.g. School A**): ………………………………………………

Topic: Algebra (Algebraic expressions manipulation)

Marks: 50 **Duration: 1 hour 30 minutes**

Pre-test questions

1. Simplify

   (a) $2a + a$

   Answer:……..……….[2]

   (b) $a(a + 8)$

   Answer:……..……….[2]

   (c) $2x - (x + 3)$

   Answer:……..……….[2]

   (d) $\frac{4a+2}{2}$

   Answer:……..……….[2]

2. Simplify.

   (a) $(x + 1)^2$

   Answer:……..……….[3]

   (b) $x(x - 1)(x + 1)$

   Answer:……..……….[3]

   (c) $(a - 2)(a + 4)$

   Answer:……..……….[3]

   (d) $(a + 2)^2 + (a - 1)^2$

   Answer:……..……….[3]

3. Divide $x^3 - 2x^2 - x - 6$ by $x - 4$ using long division; clearly indicate the reminder and the quotient.

Answer:……..……….[4]

4. Factorize completely,

(a) $4y - 6z^2$

Answer:……..……….[2]

(b) $25a^8 - b^6$

Answer:……..……….[2]

5. Factorize the following quadratic trinomials.

(a) $a^2 + 5a + 6$

Answer:……..……….[2]

(b) $2x^2 - x - 15$

Answer:……..……….[2]

6. Work out the following;

(a) $\frac{x^2-1}{x^2-x}$

Answer:……..……….[3]

(b) $\frac{a^2-5a}{a^2-11a+5}$

Answer:……..……….[3]

7. Write each of the following as a single fraction.

(a) $\frac{2x}{x} - \frac{3}{x-1}$

Answer:……..……….[4]

(b) $\frac{1}{a+1} + \frac{2}{a^2-1}$

Answer:……..……….[4]

(c) $\frac{x^2-4}{x} \div \frac{x-2}{1}$

Answer:……..……….[4]

END

APPENDIX J: LEARNERS' POST-TEST

MATHEMATICS POST-TEST

TEST FOR PARTICIPANTS

Purpose: The purpose of this study is to investigate the impacts of activity-based instruction on the grade 11 learners' performance in algebraic expressions.

Direction: Please answer all the questions. Information provided and all research material collected will be in strictest confidence and will be used for research purpose only. Your response to this test highly appreciated.

Instructions:

- Write your pseudo name and school pseudo name on the space provided.
- Answer all questions on the space provided in this question paper.
- Show all your working clearly as this would earn you marks.
- This question paper consists of 5 pages including this page (information page).

Participant name (e.g.A1):

……………………………….……………………………

Participant School's name (e.g. School A):

………………………………………………

Topic: Algebra (Algebraic expressions manipulation)

Marks: 50 **Duration: 1 hour 30 minutes**

Post-test questions

1. Simplify

(a) $4a + a$

Answer:……..……….[2]

(b) $a(a + 2)$

Answer:……..……….[2]

(c) $3x - (x + 6)$

Answer:……..……….[2]

(d) $\frac{12a+8}{4}$

Answer:……..……….[2]

2. Simplify

(a) $(x + 2)^2$

Answer:……..……….[3]

(b) $x(x - 2)(x + 2)$

Answer:……..……….[3]

(c) $(a-2)(a+2)$

Answer:……..……….[3]

(d) $(a+2)^2+(a-2)^2$

Answer:……..……….[3]

3. Divide $x^3-5x^2-32x-7$ by $x-4$ using long division; clearly indicate the reminder and the quotient.

Answer:……..……….[4]

4. Factorize completely,

   (a) $3y-6z^2$

Answer:……..……….[2]

   (b) $9a^6-b^8$

Answer:……..……….[2]

5. Factorize the following quadratic trinomials.

   (a) a^2+6a+8

Answer:……..……….[2]

   (b) $2x^2-3x-2$

Answer:……..……….[2]

6. Work out the following;

(a) $\frac{x^2-9}{x^2-3x}$

Answer:……..……….[3]

(b) $\frac{a^2-5a}{a^2-7a+10}$

Answer:……..……….[3]

7. Write each of the following as a single fraction.

(a) $\frac{3x}{x} - \frac{6}{2x-1}$

Answer:……..……….[4]

(b) $\frac{2}{a+1} + \frac{1}{a^2-1}$

Answer:……..……….[4]

(c) $\frac{x^2-2}{x} \div \frac{x-4}{4}$

Answer:……..……….[4]

END

APPENDIX K: LEARNERS MARK SCORES

Learner Code	Pre-test	Post-test
A1	18	13
A2	20	22
A3	27	28
A4	16	14
A5	26	23
A6	26	26
A7	12	11
A8	27	25
A9	16	16
A10	21	20
A11	39	35
A12	13	15
A13	26	22
A14	23	24
A15	34	36
A16	27	29
A17	10	12
A18	11	14
A19	18	18
A20	34	35
A21	11	11
A22	13	15
A23	4	8
A24	28	29
A25	19	24
A26	3	9
A27	10	13
A28	28	24
A29	33	34
A30	18	24
A31	17	11
A32	20	28
A33	7	9
A34	9	7
A35	7	7
A36	4	9
A37	13	8
A38	20	17
A39	19	17
A40	21	20

Learner Code	Pre-test	Post-test
B1	28	40
B2	15	34
B3	13	14
B4	26	33
B5	11	28
B6	7	19
B7	10	12
B8	22	39
B9	33	42
B10	41	41
B11	11	42
B12	23	37
B13	38	45
B14	7	16
B15	12	22
B16	36	43
B17	26	32
B18	12	38
B19	7	19
B20	39	42
B21	30	42
B22	14	16
B23	25	33
B24	38	39
B25	32	41
B26	13	38
B27	8	12
B28	21	30
B29	2	4
B30	21	37
B31	8	43
B32	25	39
B33	14	45
B34	26	38
B35	5	45
B36	2	4
B37	19	20
B38	15	32
B39	23	28
B40	12	38

APPENDIX L: LESSON PLAN

LESSON PLAN

MATHEMATICS RESEARCH **SUBJECT:** MATHEMATICS
GRADE: 11 **TOPIC:** ALGEBRA **DURATION:** 2 WEEEKS

1. **TEACHING RESOURCES AND MATERIALS USED:**
   - Mathematics y = mx + c textbook by Karen D.
   - Chalkboard
   - Worksheet

2. **LESSONS OBJECTIVES**
   - Algebraic manipulation
   - polynomials

3. **LESSON PRESENTATION**
   INTRODUCTION
   - State the topic and give the learners the focus of the lesson in terms of the learning objectives of the lesson.
   - Motivate learners to realise the importance listening, active participation and asking question.

   PRESENTATION OF SUBJECT MATTER AND LEARNING ACTIVITIES
   First presentation
   - Multiply a monomial by a polynomial
   - Expand products of algebraic expressions

   Second presentation
   - Use brackets and extract common factors
   - Factorize where possible, expressions of the form: $ax + ay$, $ax + bx + kay + kby$, $a^2x^2 - b^2y^2$, $ax^2 - bx + c$.

   Third presentation
   - Manipulate algebraic fractions, e.g.: $\frac{x}{3} + \frac{x-4}{2}$, $\frac{2x}{3} - \frac{2}{x-3}$, $\frac{3a}{4} \times \frac{5ab}{3}$ and $\frac{1}{x-2} - \frac{2}{x-3}$.

- Factorize and simplify expressions such as: $\frac{x^2-2x}{x^2-5x+6}$; $\frac{x^2-3x-10}{x^2-4x+5}$

Fourth presentation

- Write quadratic expressions in the form $a(x+p)^2+q$.
- Carry out division of polynomial by a binomial expression, and identify the quotient and the reminder.

LEARNING ACTIVITIES DURING LESSON PRESENTATION

Control group

- Listen and take notes
- Ask questions

Experimental group

- Listen and take notes
- Do activities individually and in groups
- Answer questions on the chalkboard
- Ask questions

4. CONSOLIDATION

- Emphasise the lesson objectives at the end of each lesson
- Conclude by summarising the main points to consider when answering question.

5. ASSESSMENT/CLASS ACTIVITIES/HOMEWORK

- Learners exposed to various activities during the lessons and homework. See appendix.

6. REFLECTION

- After repeating challenging parts, and monitoring homework before each lessons, the learners of each group seemed to have understood the topic.

Presenter: K.N Shilamba

APPENDIX M: ACTIVITIES

ACTIVITY 1

1. Find each product.

   (a) $3(5a + 2)$
   (b) $2x(2x - 5)$
   (c) $2b(2b^2 - 7b + 3)$
   (d) $-y^2(-2y^2 + 3xy - 4x^2)$

2. Expand the following algebraic expressions

   (a) $(2x + 1)(6x + 1)$
   (b) $(y + 3)^2$
   (c) $2(b - 3)^2 - 3(b + 1)^2$
   (d) $(x + 5)^2(x - 2)$

ACTIVITY 2

1. Factorise

   (a) $2b^2 - 2b$
   (b) $7bc + 14b$
   (c) $y^2 - 25$
   (d) $1 - 4x^2$

2. Factorise completely

   (a) $x^3 - xy^2$
   (b) $2a^2 - 18$
   (c) $6 - 16y + 8y^2$
   (d) $2b^2 - 13b + 15$

ACTIVITY 3

1. Simplify.

   (a) $\frac{2a-2}{a-1}$
   (b) $\frac{a}{4} \times \frac{5ab}{3}$
   (c) $\frac{x^2-9}{4} \times \frac{8}{x-3}$
   (d) $\frac{x^2+2x}{x-4} \times \frac{2x-8}{x^2-4}$

2. Express each of the following as a single fraction in its simplest form.

(a) $\frac{\mathrm{x}}{3}+\frac{\mathrm{x}-4}{2}$

(b) $\frac{2\mathrm{x}}{3}-\frac{2}{\mathrm{x}-3}$

ACTIVITY 4

1. Find the quotient and reminder

(a) $\frac{x^3+7x^2+14x+3}{\mathrm{x}+2}$

(b) $\frac{a^3-2a^2-14a-5}{\mathrm{a}+3}$

(c) $\frac{-5x^2+x^3+8x+4}{-1+\mathrm{x}}$

APPENDIX N: ASSENT FORM FOR LEARNERS

Assent form for learners

UNDERTAKING

I understand that I am under no obligation to participate, and I may withdraw at any point prior to presentation or publication of research results, without any penalty. Anonymity will be maintained, and the research will be used for academic presentation and publications.

NB: Signing below means you agree to participate in this study.

____________________________________ ________________

Name and signature Date

SIGNATURE OF PERSON OBTAINING ASSENT

In my judgement the participant is voluntarily and knowingly agreeing to participate in this research study.

____________________________________ ________________

Name and signature of person obtaining assent Date

____

Contact number