



**ENHANCING LEARNING OF GRADE 1 MATHEMATICS USING TABLETS AT A
SCHOOL IN MKHONDO**

By

GUGU MEMORY THABETHE

Student number 220068984

Dissertation submitted for the degree

Master's in Early Childhood Education

In the

FACULTY OF EDUCATION

at the

UNIVERSITY OF MPUMALANGA

Supervisor: Professor. M.G Mahlomaholo

Date of submission: 30 January 2024

DECLARATION

I, Thabethe Gugu Memory, declare that:

1. The dissertation, “Enhancing learning of Grade 1 mathematics using tablets at a school in Mkhondo”, hereby submitted for the qualification of Master’s in Early Childhood Development at the University of Mpumalanga is my independent work.
2. I have not previously submitted the same work for a qualification at/in another university/faculty.
3. The dissertation does not contain other person's data, pictures, graphs, or additional information unless expressly acknowledged as being sourced from other persons.
4. The dissertation does not contain other person's writing unless expressly acknowledged as being sourced from other researchers, where other written sources have been quoted, then (i) their words have been re-written, and the general information attributed to them has been referenced. (ii) Where their exact words have been used, their writing has been placed in italics, inside quotation marks, and referenced.
5. The dissertation does not contain text, graphics or tables copied and pasted from the internet unless expressly acknowledged, and the source is detailed in the **dissertation** and the reference section.

I hereby cede the copyright to the University of Mpumalanga.



.....

Thabethe GM

30-01-2024

ACKNOWLEDGEMENTS

Firstly, I would like to thank God, the enabler, for strength.

Special thanks to the following people:

- The study's co-researchers and my colleagues who faithfully offered their time, perceptions, and experiences and who were critical cheerleaders for me to push through difficulties.
- My family at large, especially my husband, kids and my mother, who compromised their time for me to study; thank you for the support.
- Prof. M.G. Mahlomaholo, for supporting and inspiring me throughout this journey, the lessons learned through interacting with him and the mind shift on how I look at research. If only you could be here today, but posthumously you are with us. May your soul rest in peace.
- My friends and study partners Duduzile, Nomfundo, Lungelo, Tlou and Manape, for mutual reassurance and sustenance.
- Prof Hilda Israel thank you so much for guidance.
- Lastly for editing, thank you Carmen and Prof Thipa.

DEDICATION

I would like to dedicate this study to my mother, Danisile Ngema, who got a chance to study late, and I am pretty sure she was going to reach a level higher than this if she had got the opportunity earlier in her life. Thank you so much for your support, Dlokovu.

I also dedicate this study to my husband, Makhosemvelo Thabethe, who always supports my visions and is always available even in hard times Phangode. To my children, Isanda Thabethe, Zibusiso Thabethe and Alunamda, for their continued support. I am setting a trend for you to value education and reach levels higher than mine.

Lastly, to my uncle Lloyd Ngema, thank you for your support. I know you are a busy person. Thank you for lending me your ears, but I want to challenge you to acquire this and more. And to Bongani Yende, Nosipho Manzini, Nolwazi Manzini, Sthabile Ngema, and Thando Vilakazi, the sky is the limit, my siblings; thank you for the support.

ABSTRACT

This study aims to design a strategy to enhance the learning of Grade 1 mathematics at a school in Mkhondo. This study was conducted at Gert Sibande region, KwaThandeka circuit, in the Mpumalanga Province, where one of the schools was chosen to conduct this research. This study adopted posthumanism as the theoretical framework because posthumanism moves away from enlightenment and encourages entanglements and relationality between the human and the non-human. The study uses Connectivism for its conceptual framework because Connectivism encourages learner-centred learning and the use of networks and technology such as tablets, to enable learners to access knowledge.

The study focuses on designing a strategy to enhance the learning of mathematics at a school in Mkhondo. It explores challenges that hinder the teaching of mathematics using tablets. Challenges include lesson plans that do not integrate learning outcomes and tablets, not using tablets for knowledge-building and facilitation, assessment without tablets, collaborative learning and participation, and not using tablets to teach real-life situations in mathematics.

The study uses Participatory Action Research to involve everyone in designing an effective strategy. The research team identified challenges which teachers face in enhancing the learning of Grade 1 mathematics using tablets. Through discussions and reflections, the team devised solutions and strategies to help teachers realise their objectives. Data was analysed using Critical Discourse Analysis (CDA) which critically analyses text and speech and gives meaning and ideology. CDA analyses how discourse plays itself out in society. The analysis was done to find potential strategies and solutions that help teachers enhance Grade 1 mathematics using tablets.

Keywords: Mathematics, Grade 1, tablets, posthumanism, connectivism, Participatory Action Research (PAR), Critical Discourse Analysis (CDA), teachers and enhancing.

TABLE OF CONTENTS

DECLARATION.....	i
ACKNOWLEDGEMENTS.....	ii
DEDICATION.....	iii
ABSTRACT.....	iv
LIST OF TABLES.....	xii
LIST OF FIGURES.....	xiii
LIST OF ABBREVIATIONS/ ACRONYMS.....	xiv
CHAPTER 1 INTRODUCTION AND OVERVIEW OF THE STUDY	1
1.1 INTRODUCTION.....	1
1.2 PROBLEM STATEMENT.....	5
1.3 RESEARCH QUESTION.....	5
1.4 RESEARCH AIM	6
1.5 RESEARCH OBJECTIVES.....	6
1.6 THEORETICAL FRAMEWORK.....	6
1.7 CONCEPTUAL FRAMEWORK.....	7
1.8 LITERATURE REVIEW	8
1.9 RESEARCH DESIGN AND METHODS	10
1.10 THE RESEARCH SITE	11
1.11 GAINING ENTRY	11
1.12 THE RESEARCH TEAM	12
1.13 DATA GENERATION.....	12
1.14 DATA ANALYSIS	13
1.15 VALUE OF THE RESEARCH.....	13
1.16 ETHICAL CONSIDERATION.....	14
1.17 CONFIDENTIALITY	14
1.18 ANONYMITY	14
1.19 LAYOUT OF THE CHAPTERS.....	15
1.20 RESEARCH TIMELINE	15
1.21 CONCLUSION	15
CHAPTER 2 THEORETICAL AND CONCEPTUAL FRAMEWORK, AS WELL AS LITERATURE REVIEW TOWARDS ENHANCING THE LEARNING OF MATHEMATICS USING TABLETS	17

2.1 INTRODUCTION	Error! Bookmark not defined.
2.2 THEORETICAL FRAMEWORK	17
2.2.1 Historical origins of posthumanism	18
2.2.2 Objectives.....	18
2.2.3 Steps	20
2.2.4 Different formats of Posthumanism	20
2.2.5 Epistemology	21
2.2.6 Ontological stance	22
2.2.7 The language/ rhetoric.....	23
2.2.8 The role of the researcher in Posthumanism	23
2.2.9 The importance of Posthumanism in this study	24
2.2.10 The relationship with the researcher and co-researcher.....	24
2.3 DISCUSSION OF THE CONCEPTUAL FRAMEWORK.....	25
2.3.1 What is connectivism?	26
2.3.1.1 Origins of connectivism.....	26
2.3.1.2 Learning in connectivism	26
2.3.1.3 Challenges faced by connectivism	27
2.3.1.4 Steps in applying connectivism	27
2.3.1.5 Principles of connectivism.....	28
2.3.1.6 The role of the researcher in connectivism.....	29
2.3.2 Relevance to the study	29
2.4 RELATED LITERATURE	29
2.4.1 Challenges towards the enhancement of learning mathematics using tablets.....	29
2.4.1.1 Challenges on lesson plans that integrate learning outcomes without using tablet	29
2.4.1.2 Challenges of knowledge-building and facilitation not using tablets	31
2.4.1.3 Challenges of assessment without using tablets.....	32
2.4.1.4 Challenges to collaborative learning and participation not using tablets	33
2.4.1.5 Challenges with teaching involving real-life situations without using tablets ..	34
2.4.2 Solutions for challenges.....	35
2.4.2.1 Teachers cannot create lesson plans that integrate lesson outcomes with tablets.	35
2.4.2.2 Knowledge-building and facilitation not using tablets	35
2.4.2.3 Creating assessments not using tablets.....	36

2.4.2.4	Collaborative learning and participation without using tablets	36
2.4.2.5	Challenges with teaching involving real-life situations without using tablets ..	37
2.4.3	Conductive conditions that ensure effective use of tablets to enhance the learning of mathematics	38
2.4.4	Anticipated threats and how to circumvent them when using tablets for teaching and learning mathematics	40
2.5	SUCCESS INDICATORS OF THE STUDY	42
CHAPTER 3 RESEARCH DESIGN AND METHODOLOGY TOWARDS ENHANCING THE LEARNING OF GRADE 1 MATHEMATICS USING A TABLET		45
3.1	INTRODUCTION	45
3.2	HOW DID WE GET INVOLVED?	46
3.2.1	The role of the researcher	46
3.2.2	The relationship between the researcher and co-researchers	46
3.3	PARTICIPATORY ACTION RESEARCH (PAR) AS A RELEVANT APPROACH	47
3.3.1	Historical origin of Participatory Action Research (PAR)	47
3.3.2	Objectives of Participatory Action Research (PAR)	48
3.3.3	Formats of Participatory Action Research (PAR)	48
3.3.4	Steps and stages in Participatory Action Research (PAR)	48
3.3.5	Epistemological stance of Participatory Action Research (PAR)	49
3.3.6	Ontological stance of Participatory Action Research (PAR)	49
3.3.7	Rhetoric language of Participatory Action Research (PAR)	50
3.3.8	Challenges of Participatory Action Research (PAR) as a research method	50
3.3.9	Success indicators of Participatory Action Research (PAR)	51
3.4	RESEARCH SITE	51
3.5	GAINING ENTRY	51
3.6	ETHICAL CONSIDERATION	52
3.7	HUMAN AND PHYSICAL RESOURCES FOR DATA GENERATION	52
3.7.1	The coordination team	53
3.7.2	The research coordinator	53
3.7.3	Credentials of the learner	53
3.7.4	Credentials of Grade 1 class teacher	54
3.7.5	Credentials of Foundation Phase teachers	54
3.7.6	Credentials of the Head of Department (HoD)	54
3.7.7	Credentials of parents	55

3.7.8 Credentials of the principal	55
3.8 STRENGTH / WEAKNESSES / OPPORTUNITIES/ AND THREATS (SWOT) ANALYSIS	
56	
3.8.1 Strengths.....	56
3.8.2 Weaknesses.....	56
3.8.3 Opportunities	57
3.8.4 Threats.....	57
3.9 CONCEPTUALIZING THE STUDY	57
3.10 STRATEGIC PLAN	58
3.10.1 Identifying the team	61
3.10.2 Identifying the resources to be used	61
3.10.3 Formulating the project plan.....	62
3.10.4 Joint analysis of data	62
3.10.5 Formalization of results.....	62
3.10.6 Taking action	63
3.10.7 Monitoring the implementation and captured data.....	63
3.11 TOOLS FOR GENERATING DATA.....	63
3.11.1 Video and voice recorder	63
3.11.2 Document analysis	64
3.11.3 Participant observer	64
3.11.4 Free attitude interview (FAI) technique	64
3.11.5 Data generation	64
3.12 DATA ANALYSIS THROUGH CRITICAL DISCOURSE ANALYSIS (CDA)	65
3.12.1 Textual level	66
3.12.2 Discursive level.....	66
3.12.3 Social level of analysis.....	67
3.13 SUMMARY OF THE CHAPTER	68
CHAPTER 4 CHAPTER 4: ANALYSIS OF DATA, PRESENTATION, AND INTERPRETATION	
OF RESULTS	69
4.1 INTRODUCTION	69
4.2 IDENTIFICATION OF CHALLENGES TO ENHANCE LEARNING MATHEMATICS IN	
GRADE 1	69
4.2.1 Lesson plans that do not use tablets in designing learning outcomes	69
4.2.2 Knowledge-building and facilitation of Grade 1 mathematics without using a tablet	72

4.2.3 Assessment that does not use tablets	74
4.2.4 Collaborative learning and participation of learners without using tablets	76
4.2.5 Teaching mathematics involving real-life situations without using tablets	78
4.3 SOLUTIONS TOWARDS CHALLENGES TO ENHANCE LEARNING OF GRADE 1 MATHEMATICS USING TABLETS	79
4.3.1 Development of lesson plans that integrate with tablets in designing learning outcomes	80
4.3.2 Solutions to knowledge-building and facilitation	81
4.3.3 Solutions to creating assessments using tablets	82
4.3.4 Solutions to collaborative learning and participation	83
4.3.5 Solutions to teaching mathematics involving real-life situations using tablets	84
4.4 ANALYSING CONDUCIVE CONDITIONS TO ENHANCE THE LEARNING OF MATHEMATICS IN GRADE 1	85
4.4.1 Conditions conducive to creating lesson plans that integrate lesson outcomes with tablets	85
4.4.2 Conditions conducive to building knowledge and facilitation using tablets	86
4.4.3 Conditions conducive to creating assessments that integrate with tablets	87
4.4.4 Conditions conducive to collaborative learning using tablets	88
4.4.5 Conditions conducive to using real-life situations in mathematics using tablets	89
4.5 IDENTIFICATION OF POSSIBLE THREATS WHEN USING TABLETS TO ENHANCE THE LEARNING OF MATHEMATICS IN GRADE 1	90
4.6 THREATS TO THE CREATION OF LESSON PLANS THAT INTEGRATE LESSON OUTCOMES WITH TABLETS	90
4.6.1 Threats to building knowledge and facilitation using tablets	91
4.6.2 Threats to assessments using tablets	91
4.6.3 Threats to collaborative learning and participation using tablets	92
4.6.4 Threats to involving real-life situations in fractions using tablets	92
4.7 EVIDENCE OF SUCCESSFUL STRATEGY TO ENHANCE LEARNING OF GRADE 1 MATHEMATICS USING TABLETS	93
4.7.1 Evidence of success in creating lesson plans that integrate tablets	93
4.7.2 Evidence of success in knowledge-building and participation using tablets	95
4.7.3 The use of tablets in assessments	96
4.7.4 Evidence of success in using tablets in collaborative and participation learning ...	98
4.7.5 The use of tablets when learning mathematics involving real-life situations	100

4.8 CONCLUSION.....	101
CHAPTER 5 SUMMARY OF FINDINGS, RECOMMENDATIONS, AND CONCLUSION	102
5.1 INTRODUCTION.....	102
5.2 FINDINGS AND DISCUSSIONS.....	102
5.3 CHALLENGES TO ENHANCING LEARNING OF GRADE 1 MATHEMATICS USING TABLETS	102
5.3.1 Teachers are not able to plan lessons that integrate lesson outcomes and tablets 102	
5.3.1.1 Recommended strategies for creating lesson plans that integrate tablets and learning outcomes	103
5.3.2 Lack of knowledge-building and facilitation using tablets	104
5.3.2.1 Recommended strategy for knowledge-building and facilitation using tablets 104	
5.3.3 Teachers not using tablets when doing assessments	105
5.3.3.1 Recommendations on conducting assessments using tablets.....	105
5.3.4 Challenge on collaborative learning and participation using tablets	106
5.3.4.1 Recommendations on collaborative learning and participation using tablets 107	
5.3.5 Teachers not using tablets when teaching mathematics content that involves real-life situations.....	107
5.3.5.1 Recommendations on using tablets when teaching mathematics content that involves real-life situations.....	108
5.4 STRATEGIES FOR ENHANCING THE LEARNING OF GRADE 1 MATHEMATICS AT A SCHOOL	108
5.5 RELEVANCE OF THE STUDY	109
5.6 VALUE OF THE STUDY	109
5.7 SUCCESS IN DESIGNING A STRATEGY	110
5.8 METHODOLOGICAL CONTRIBUTION	111
5.9 LIMITATIONS OF THE STUDY	112
5.10 SUMMARY OF THE STRATEGY	113
5.11 CONCLUSION	114
REFERENCES.....	115
APPENDICES	135
APPENDIX 1: ETHICAL CLEARANCE FOR UNIVERSITY OF MPUMALANGA	135

APPENDIX 2: LETTER FROM LANGUAGE EDITOR.....	136
APPENDIX 3: PLAGIARISM (TURN IT IN) REPORT	143

LIST OF TABLES

Table 1.1: Priorities template.....	13
Table 1.2: Research timeline.....	15
Table 3.1: Study priorities	58

LIST OF FIGURES

Figure 4.1: Lesson plan that does not integrate a tablet	71
Figure 4.2: Learners using empty packets for data handling.....	71
Figure 4.3: Teacher teaching a few available shapes properties and learners' activity	73
Figure 4.4: Assessment with no feedback and assessment done orally without checking the level of understanding	75
Figure 4.5: WhatsApp homework with no information detailed	76
Figure 4.6: Number bonds addition without using tablets.....	77
Figure 4.7: Learners' activity attempts in money addition sum without tablets	78
Figure 4.8: Teacher development in lesson plans using tablets	80
Figure 4.9: Development of knowledge-building	81
Figure 4.10: Online teacher development.....	82
Figure 4.11: Online development in a real-life situation	85
Figure 4.12: Lesson plan integrating tablets	94
Figure 4.13: Building knowledge using tablets.....	95
Figure 4.14: Assessments using quizzes on tablets	97
Figure 4.15: Giving speedy feedback	97
Figure 4.16: Collaborative learning using a tablet.....	98
Figure 4.17: Collaborative Learning on YouTube	99
Figure 4.18: Real-life situations on tablets.....	100

LIST OF ABBREVIATIONS/ ACRONYMS

CAPS	Curriculum Assessment Policy Statement.
CDA	Critical Discourse Analysis
DBE	Department of Basic Education
DoE	Department of Education
FAI	Free Attitude Interview
ICT	Information and Communication Technologies
HoD	Head of Department
PAR	Participatory Action Research
SMT	School Management Team
SWOT	Strengths, Weaknesses, Opportunities and Threats

CHAPTER 1

INTRODUCTION AND OVERVIEW OF THE STUDY

1.1 INTRODUCTION

This study aims to enhance the learning of Grade 1 mathematics using tablets at a school in Mkhondo. Singapore will be used briefly as a reference point. The enhancement of learning in Singapore impacts positively on a learner's attributes, knowledge, ability, skills and potential (Muchmud, Widiyani & Ramadhani, 2021:79). In addition, Oojorah and Udhin (2022:101) describe this enhancement as improving creativity, communication and collaboration skills. Grade 1 in Singapore, and also in Mauritius and South Africa for example, comprises learners aged between six and seven years (NYCBE Booklet, 2016:19).

Mathematics content for Grade 1 in Singapore and Mauritius includes Statistics and probability. The content is similar to the South African mathematics curriculum CAPS (DBE, 2011:89). A Tablet, the subject of this study, is something that is light in weight, and is a portable touch screen gadget. It has different applications to enhance problem-solving skills in learners (Ramjaun, Atchia & Reiss, 2022:10). Against the background of the foregoing, the focus of this study is on how tablets can impact positively on learners' attributes, skills, and knowledge in attaining creativity, collaboration and communication in order to improve the learning of mathematics in Grade 1 at Mkhondo.

Previous research discovered different challenges in using tablets in mathematics in Grade 1. In Singapore, the lack of relevant applications that are content-based hindered the enhancement of learning mathematics skills as per the curriculum (Attard, Calder, Holmes, Larkin & Trenholm, 2021:320). Mauritius learners could not create or invent their own mathematics problem-solving methods. They lacked creative handwriting skills (Oqaibi, Basuhail & Abosamra, 2021:2). In contrast, in South Africa, learners were not able to use technological applications in solving critical mathematics problems (Johnson, Smail, Corey & Jaraha, 2022:2). According to Triantafillou, Psycharis and Potari (2021:9), collaboration in doing mathematical problems using tablet amongst Grade 1 learners and teachers was still neglected in Singapore.

Teachers in Mauritius find it challenging to involve learners in collaborative discussions for analysing mathematical problems (Williams & Von Mengersen, 2022:271). In South Africa, collaboration in solving mathematical problems was not reached due to the lack of application knowledge installed in tablets (Mokotjo & Mokhele, 2021:11). Lack of resources in Singapore slowed communications where teachers' presentations couldn't reach all learners (Muchmud et al., 2021:79). Inadequate resources in Mauritius created difficulties of accessing online lessons especially to underprivileged learners (Bhaug eerutty, 2021:11) and in South Africa a massive shortage of technological resources including internet access hindered communication (Herselman, Botha, Dlamini, Maremi & Marias, 2020:11).

Though teachers and learners lack collaboration and communication skills, and applications cannot enhance creativity and critical thinking, tablets are still considered good gadgets for teaching mathematics. Hence, this study will try to resolve the challenges that are encountered.

Solutions were researched and proven to work for challenges when using a tablet in Grade 1 mathematics. A plan in Singapore to create digital games that stimulate creativity and critical thinking involves pattern and shape quizzes resolved on complex and content-based application software (Szymanski, Paganelli & Tassell, 2022:507). This also occurred in Mauritius, where new policies were drafted to familiarise teachers with teaching the correct curriculum using tablets (Ramjaun et al., 2022:17). In contrast, in South Africa, the creation of digital lesson planning helped teachers to be in line with the content (Hardman & Lilley, 2020:65). The provision of resources to teachers and learners, implemented in Singapore, also increased the use of more technological resources for teaching and collaborative learning (Muchmud, Widiyan & Ramadhani, 2021:83).

Mauritius provided tablets for every learner, even at home, increasing communication (Connectivities, 2021:102). Electronic textbooks were created in South African rural schools. Then there was the distribution of tablets and computers to promote collaboration and communication in learning (Masango, Ryneveld & Graham, 2022:18). Online videos on YouTube were a success in Mauritius as many learners were able to access and learn mathematics at any time (Nabayra, 2022:1381), and a plan to develop

teachers on planning lessons that are technologically based made them aware of the digital Blooms Taxonomy structure in South Africa (Theunissen, 2021:5). The creation of content-based applications, the provision of adequate resources to promote collaborative problem-solving and communication and the creation of digital educational games that stimulate creativity and critical thinking were the solutions for the countries mentioned above, hence this study seeks to explore more solutions in Mkhondo.

The implementation of new strategies to use tablets came with dedication and yielded much commitment until it was successful. Curriculum bridging in Singapore to make it in line with technology and the creation of applications that are content-based needed a lot of money (Appavoo, 2021:26). Mauritius supplied tablets even in rural areas, making it that everyone in their country can communicate and collaborate effectively when learning mathematics (Myers, 2021:321).

In South Africa, tablets were provided to previously disadvantaged learners to access study materials and teachers' presentations easily (Masango et al., 2022:10). Singapore also invented video tutorials where every learner could access lessons even when they were at home due to any connectivity. This encouraged everyone, including parents, to be aware and be equipped with critical and creative skills (Haleem, Javaid, Qadri & Suman, 2022). In Mauritius, global lessons were also encouraged in order to learn skills for solving mathematical problems using methods utilised by other countries to properly master content topics (Muchmud et al., 2021:72).

Learners seemed to spend more time learning on tablets than using books and were able to solve mathematical problems together in South Africa (Tawil, Haddad, Farchakh, Sacre, Nabout, Obeid, Salameh & Hallit, 2022:142). The exposure of early graders to using tablets enables them to gain creative skills. Consequently, when doing assignments they excelled in their mathematics performance (Shamir, Yader, Pocklington, Feehan & Ortiz-Wood, 2022:9). This study is a necessity because it will apply most of the strategies and will seek to design more strategies to enhance the learning of mathematics using tablets in Grade 1 at Mkhondo.

For solutions to be successful, many risks are taken to test new approaches to teaching and learning. The effective use of tablets in Singapore to communicate tasks that are to

be completed was risky as some learners and parents were still not able to communicate appropriately using tablets (Toh, Coenen, Howie, Mukherjee, Mackey & Straker, 2019:6). Mauritius took the risk without examining the readiness of learners and teachers to collaboratively learn mathematics using tablets (Bholoa, Ramma, Jaweheer,, Moheeput & Atchia, 2020:19).

The introduction of a new teaching system risks the pass rate of learners since it has not yet proven its effectiveness in producing good results (Topal, 2021:22). There is also the risk by parents who buy tablets to bridge a shortage gap without being sure that they will bring the best results in South Africa (Ogegbo & Aina, 2020:78). This study will focus on solutions that will be effective for the school in Mkhondo, being cautious of the fact that the school is still developing; it is not at the level of schools in Singapore or Mauritius. My purpose is to improve the learning of mathematics in Grade 1 in this particular school. With time, this may even extend to neighbouring schools so that they too achieve better results.

To adapt to change and be successful requires a great deal of effort and results in achieving the best on your own and even when compared to different countries. Singapore is widely known to be the best in teaching mathematics, as was revealed at the Trends in International Mathematics and Science Study [TIMSS] (Mullis, Martin, Foy, Kelly & Fishbein, 2019), where they came first. Studies have shown that facing challenges and finding solutions will improve learner performance, and tablets are good gadgets to deliver such success (Achia & Chinapah, 2022:53).

Singapore's curriculum teaches learners to understand each concept taught profoundly and makes it possible for them to master all the content so they can apply it, as each grade has its level (Vicente, Sanchez & Verschaffel, 2020:321). According to the SACMEQ, a project, Mauritius came second in mathematics scores because of the dedication to curriculum improvement, teacher development, addressing the inequalities of their students by providing for those in need and proper adaptation to using technology in mathematics at foundation levels. South Africa is also rated as one of the best in the SADC region. Even with all these efforts, some places are still not effectively using tablets

in teaching mathematics; thus, this study is essential to enhance the learning of mathematics in Grade 1 in Mkhondo.

1.2 PROBLEM STATEMENT

This study aims to enhance the learning of Grade 1 mathematics using tablets in Mkhondo. The use of tablets may have a positive impact on learners' attributes, skills, and knowledge in attaining creativity, collaboration and communication in order to improve the learning of mathematics in Grade 1 (Nikolopoulou, 2020:18). The emphasis on teaching mathematics in early grades is regarded as crucial as it equips learners with good mathematical skills (Chirinda, Ndlovu & Spangenberg, 2021:25). When mathematics is taught in an effective manner learners are empowered to apply logic and solve mathematical problems (Jojo, 2019:89). The use of tables in Grade 1 mathematics is encouraged by the Department of Basic Education (DBE), thus always trying to provide schools with technological gadgets (DBE, 2020:7). The importance of teacher development in facilitating the use of the prescribed curriculum and stimulating creative and critical thinking skills when structuring activities using tablets (Cilliers, Fleisch, Kotze, Mohohlwane, Taylor & Thulare, 2022:95) cannot be overemphasized. The provision of enough and efficient resources should be implemented for achieving collaborative learning and communication to enhance learning mathematics in Grade 1 (Ogegbo & Aina, 2020:15). More research still needs to be conducted in this matter. This study is still relevant and necessary to find ways of enhancing the learning of mathematics using tablets in Grade 1 at a school in Mkhondo.

This study is designed to assess the hypothesis that the use of tablets, equipped with proper resources and applications, can improve targeted learning outcomes in mathematics in Grade 1.

1.3 RESEARCH QUESTION

How can we enhance learning mathematics in Grade 1 using a tablet in a school in Mkhondo?

1.4 RESEARCH AIM

To design a strategy to enhance learning of Grade 1 mathematics using a tablet in Mkhondo.

1.5 RESEARCH OBJECTIVES

1. To investigate the challenges of enhancing the learning of mathematics using a tablet in Grade 1.
2. To explore solutions to the challenges of enhancing the learning of mathematics in Grade 1 in Mkhondo.
3. To analyse conducive factors for enhancing the use of tablets in learning mathematics in Grade 1.
4. To identify possible threats of teaching mathematics when using tablets in Grade 1.
5. To investigate whether the solutions to the challenges acknowledged are operative.

1.6 THEORETICAL FRAMEWORK

The theoretical framework that guides this study is Posthumanism. According to Yenidogan (2021:3), posthumanism is human enrichment with ecological and technological elements that can only co-exist with non-humans. Furthermore, Gambino (2021:118) define posthuman as the technology capable of immensely outclassing humans. At the same time, Nath and Manna (2023:186) predict the future companions of the lives of human beings as the technological machines that provide artificial intelligence.

Posthumanism is described by three categories: post-humanism, post- anthropocentrism and post-dualism. Posthumanism says ‘human’ is not one notion; hence ‘human’ is deconstructed in class, gender, nationality, class, race, disability and ethnicity (Nath & Manna, 2023:185). Post-anthropocentrism defines humans by relation to the biosphere, culture and speciesism (Corona, Lanniello & De Giuseppe, 2020:2).

Post-dualism says it is not enough to define humans as there will always be an interconnection between humans and technology, biology and ecology (Fox & Aldred, 2020:122). Posthumanism concerns social justice in education concerning our

technological principles, our relationship to our self and nature, how we relate to the world and our relationship with intelligence systems (Fox & Alldred, 2020:16). Posthumanism suggests that teachers start adopting more technological materials to achieve most educational goals (Lemieux, 2021:494). Dube, Mahlomaholo, Sentlaletoa and Tarman (2023:7) recommend post-humanism as the adaptive way of attaining sustainable learning environments with the relevant curriculum.

Posthumanism is relevant to this study. It defines technology as one of the different ways to implement the abstract connection between technology and humans (Lemieux, 2021:494). Hence, this study emphasises that teachers are not the only source of knowledge for learners; tablets come in handy to equip learners with relevant skills in mathematics. This study focuses on enhancing the learning of mathematics in Grade 1 using tablets in a school at Mkhondo.

1.7 CONCEPTUAL FRAMEWORK

The conceptual framework that guides this study is connectivism. Connectivism is a framework that helps to understand that learning in a digital age is all about making connections and using available networks. Furthermore, in connectivism environments, learning is viewed as the process of exploring the network and pattern recognition (Yu, 2021:2). George Siemens first introduced this theory, which viewed traditional learning theories as inadequate and named it a digital age theory (Corbett & Spinello, 2020:2).

The Connectivism theory aims to find the knowledge that is in a system or organization when it is needed. Furthermore, it determines whether the knowledge is still valid or acceptable and tries to recognise whether there are links in the meta-information characterised by its autonomy, openness, connectedness, and diversity (Boyras & Ocak, 2021:1226). Connectivism, when used in the classroom, follows the following five steps: determining the teaching activities, explaining the knowledge points, group discussion, extension exercise and practice (Yu, 2021:3). Learning in the connectivism environment involves three cyclic phases: planning, cognitive processing and evaluation (Al Dahdouh, 2021).

In connectivism settings, the teacher's role is to create a learning platform and context that can help learners to construct their learning environments through network connections (Yu, 2021:3). Another reason the connectivism theory is chosen as a conceptual framework for this study is that it advances the idea that learning is no longer confined to school facilities and infrastructure/ classrooms. However, technology-enhanced tools and media enable new modes of learning (Kotze, 2022:15). Connectivism is a learning theory that can bring out an in-depth understanding of the learning skills that involve various technologies and tasks needed for learners to flourish in a digital era, in the same way emphasizing that learning has changed and that technology influences how we learn and where we learn (Vitoulis, 2022:4). Learners are regarded as active users of knowledge driven by the dynamic flow of information in collaboration with the environment and interaction with others.

1.8 LITERATURE REVIEW

This study aims to design a strategy for using tablets to enhance the learning of mathematics in Grade 1 at a school in Mkhondo. Research and theory have proven that tablets help increase learners' mathematics and life skills knowledge by doing application activities that test their knowledge (Muchmud et al., 2021:75).

Tablets help to stimulate problem-solving and critical thinking skills by doing puzzles that involve patterns (Papadakis, Kalogiannakis & Zaranis, 2021:15). Using technological gadgets reaches too many learning outcomes, for example, developing number concepts (Simsek & Can, 2020:231).

Teachers who use technological tools effectively improve collaborative teaching and learning as they create relevant lesson plans using tablets (Muchmud et al., 2021:70). Tablets also enable teachers to facilitate the learning of mathematics easily and efficiently (Sungkur, Maharaj, 2021). Teachers in Singapore use tablets to create effective teaching aids (Haleem et al., 2022). Teachers must use tablets to make their work easy and efficient.

A tablet is a powerful tool to enhance the learning of mathematics; thus its potential must be explored and examined. Nabayra (2022:54) says that in Mauritius, tablet applications, Google Classrooms and YouTube classes helped learners with their addition and subtraction knowledge as they used tablets to test their skills. Singapore made the most beneficial applications, games and tasks that operate without depending on data or network. These applications developed number sequence and multiplication (Muchmud et al., 2021:84). Proper device management and awareness helped learners and teachers to be able to draw graphs using tablets in South Africa (Msiza, Malatjie & Mphahlele, 2020:36).

Although tablets are necessary to improve the learning of mathematics, several challenges hinder their proper utilization. The lack of resources in Singapore limited them, but they later devised a strategy to provide every learner and teacher with tablets (Muchmud et al., 2021:85).

The shortage was also experienced in Mauritius, yet a plan to issue even previously disadvantaged learners with tablets helped to promote the learning of mathematics online (Bhaugeerutty, 2021:785). South African children received tables that had test books, which enabled them to master topics in mathematics by comparing different books that expand on them (Masango et al., 2022:12). So many challenges include applications that are not content-based, some lack the strategy of posing questions which end up testing low cognitive level.

The assessment of learners became easy and progressive as teachers could test learners with different learning cognitive skills. In Singapore, a mathematics application that tests learners' multiplication and division skills progressed as the learner master; if not, the application will repeat the same level questions that are set by the teacher (Appavoo, 2021:30). Proper policy development was done in Singapore to accommodate and support the teaching of mathematics with ICT (Muchmud et al., 2021:82). This study seeks to design a strategy that enhances the learning of mathematics in Grade 1 using a tablet.

1.9 RESEARCH DESIGN AND METHODOLOGY

This study uses Participatory Action Research (PAR) to articulate a plan to enhance the use of tablets in teaching mathematics in Grade 1 at a primary school in Mkhondo. PAR is an epistemological framework that reconfigures ways of knowing in the pursuit of worthwhile human purposes to foster action for communal integrity (Galletta & Torre, 2019:1). PAR is an ongoing commitment that can be traced back to Kurt Lewin, who is considered to be the founder of action research, a Prussian Psychologist who was a Jewish refugee from Nazi Germany, John Elliott, Clem Adelman from Britain, and Paolo Freire (Vaughn & Jacquez, 2020:1).

According to Goessling (2020:13), participants in PAR are regarded as active contributors to a study, as they possess relevant knowledge of a study under investigation. The paramount importance of PAR is to empower people and inspire participation. The characteristics of PAR are that it allows the democratic involvement of participants, acknowledges people's worth and provides freedom of expression (Halliday, Kern, Garrett & Turnbull, 2019:174).

According to Thurber, Collins, Greer and Mcknight (2020), PAR is an alternative research approach that assists with resolving problems. Building powerful relationships, paying more attention to individuals and engaging them result in a collaborative sharing of knowledge that helps find solutions together (Teele, Nkoane & Mahlomaholo, 2020:3).

PAR is relevant to this study as it aims to improve the learning of mathematics in Grade 1 using a tablet to improve the pass rate. PAR investigates the actual practices rather than the abstract practices of learning that involve essential material, concrete and particular practices of particular people in specific places (Dube, 2020:141).

This study aims to formulate a strategy that will improve teaching and the learning of mathematics using tablets, a resource that is easily accessible at their school. The strategy will be formulated together with the people affected, referred to as the co-researchers following the principles of PAR.

I have realised that using tablets to improve the learning of mathematics is inefficient in the Mkhondo School. Hence, this study aims to empower teachers and equip learners

with skills that will enhance their knowledge of mathematics by using a tablet and co-researchers to find a suitable solution. Hence, PAR is very suitable for this study.

1.10 THE RESEARCH SITE

The research site for this study is a primary school in the deep rural area of Mpumalanga Province, in Gert Sibande district at KwaThandeka Circuit. Muddy forests and gravel roads surround the school's geographic setting during rainy seasons. It is a quintile one school and part of the MST (Mathematics, Science and Technology) schools that were provided with technology gadgets such as tablets, laptops and interactive whiteboard in the Province. The community is impoverished, mostly having migrants from Eswatini. The classes are well built with an addition of three container schools. Teaching and learning conditions are generally of an average standard.

Most of the parents of the learners in this area work in the forestry. They leave home early in the morning and return late at night; some only depend on social grants. The school has Grades R-7 and an enrolment of 310 learners. It has nine teachers and two support staff members. The school has been performing poorly in Grade 1 mathematics for the previous years, according to subject analysis and this poor performance also affected the following grades. The school team suggested the use of tablets to help increase performance as they were provided for. This resulted in challenges of not being able to use the tablets to enhance performance. The teachers had the most skills and the ability to use the tablet to teach with teaching different mathematics outcomes, chose correct applications that are in line with the curriculum, ways of purposeful assessment, signal issues, enough resources, communication and collaboration skills using tablets to increase performance in mathematics. The school and the area where it is located are fertile ground for conducting this study.

1.11 GAINING ENTRY

I wrote a letter to the school's principal, circuit and Department of Education to request permission to conduct research there. The researcher wrote letters to the identified team

members requesting them to participate in the study. Letters of consent were written to parents of the learners involved in the study requesting them to allow their children to participate. The problem under investigation was explained in the letter. Their rights were explained in the letter. The team identified a study coordinator to coordinate study activities, a scribe and a recorder to take minutes of meetings and invite members to meetings.

1.12 THE RESEARCH TEAM

The research team was identified and established through negotiations with the School Management Team (SMT), the Head of Department (HoD) and the mathematics team, who assisted in identifying the different stakeholders involved in the study. The research team consisted of one principal, one HoD in the Foundation Phase, one teacher and ten learners.

The focus was on how the use of tablets can enhance the learning of mathematics. A sequence of topics and competencies to teach guided by the curriculum units and daily lesson plans was planned. The teachers were observed when teaching; photos and video recordings were taken. Observation notes were taken and transcribed, followed by meetings to discuss the content covered and skills observed. Discussions on the effectiveness of the interactions and processes were conducted. The research team monitored the proceedings of the whole process of data generation.

1.13 DATA GENERATION

Data was generated using SWOT analysis, reflecting on the collected data's strengths, weaknesses, opportunities, and threats (Teele et al., 2020:109). The team members were the co-researchers who bring the change this study aimed to bring. The research process was organised from April 2023 to October 2023.

My responsibility was to discuss challenges experienced by teachers when not using tablets in teaching mathematics, how they can integrate tablets in their teaching of mathematics in Grade 1 and how using tablets could enhance the learning of

mathematics. Several additional discussions followed, and team members were responsible for formulating the strategy. These meetings were voice-recorded and video-recorded. Notes were taken during the sessions and were transcribed and analysed.

Table 1.1: Priorities template

PRIORITIES	ACTIVITY	RESPONSIBLE PERSON	RESOURCES	TIME FRAMES	MONITORING

1.14 DATA ANALYSIS

Data was analysed using Critical Discourse Analysis (CDA). CDA reviews and analyses transcribed and verbal texts to disclose the discursive bases of power, inequality, dominance and bias (Teele et al., 2020:109). According to Trochmann, Viswannath, Puello and Larson (2022:159), CDA has different stages, which include the identification of a social problem, possible obstacles towards addressing the social issue, analysis of whether the social problem serves a bigger purpose and classification possibilities to solve a social problem. Data was analysed from photos, videos and audio recordings of meetings and discussions (Teele et al., 2020:109).

1.15 VALUE OF THE RESEARCH

This research helped teachers to use tablets when teaching learners. It also improved the teaching and learning atmosphere by upgrading to technological gadgets. It further increased the pass rate in mathematics in Grade 1. School principals and management

teams can use the information gathered in this study to support and provide relevant ICT tools and training for their teachers and staff. SMTs and principals can build solid and productive relationships with great adaptation of ICT tools and the community to provide better education for their children.

1.16 ETHICAL CONSIDERATION

Ethical clearance was sought according to the rules of the University of Mpumalanga. Permission from the Department of Basic Education (DBE) in Mpumalanga to conduct research was also requested. Permission was requested from all team members or co-researchers in this study, and the purpose of this study was explained to all the participants.

1.17 CONFIDENTIALITY

In this study, confidentiality was discussed and confirmed. Co-researchers had to follow the agreed standards and ensure no risks or benefits occurred to them. Team members were treated with respect, and no harm was expected in this study. Findings were reported with discretion, and findings were communicated to participants through their preferred methods of communication. Information was stored in a computer that is only accessible to the researcher.

1.18 ANONYMITY

In a PAR, it is not easy to ensure anonymity as the researcher plays numerous roles in a setting where co-researchers know one another. All research teams know the participants of the study. People's individuality was masked where necessary, and pseudonyms were used.

The rights of co-researchers were explained and certified. All documents, recordings and photos were stored safely and later discarded according to the rules of research expected by the University. Letters of assent and consent were issued to all team members. All team members were treated with respect throughout the study, and no harm or

exploitation was anticipated in this study. Issues of social justice and democracy were obeyed.

1.19 LAYOUT OF THE CHAPTERS

Chapter 1 will be the introduction and background to the study, problem statement, research question, research aim and objectives. Chapter 2 will focus on the literature review, the theoretical framework guiding the study and the conceptual framework. Chapter 3 will present the research design and methodologies and discuss how data will be generated. Chapter 4 will focus on data analysis, presentation and interpretation. Chapter 5 presents the conclusion, summary of findings and recommendations of the study.

1.20 RESEARCH TIMELINE

Table 1.2: Research timeline

RESEARCH ACTIVITY	TIME IN MONTHS
1. Submission of Research Proposal	April 2023
2. Chapter 1. (Introduction and Background)	May 2023
3. Chapter 2 (Literature review)	June 2023
4. Chapter 3 (Data generation)	July 2023
5. Chapter 4 (Data analysis)	August 2023
6. Chapter 5 Recommendations and Conclusion.	September 2023
7. Finalization of the first draft	September 2023
8. Submission for Examination	October 2023

1.21 CONCLUSION

This study aims to design a strategy to enhance the usage of tablets in teaching Grade 1 mathematics in a primary school in Mkhondo. This chapter presents the background of the study and the problem statement. It discusses the study's objectives, briefly

discussing the theoretical and conceptual framework, the research design and methodology, data analysis and the layout of chapters.

CHAPTER 2

THEORETICAL AND CONCEPTUAL FRAMEWORK. LITERATURE REVIEW.

This study aims to design a strategy for enhancing the learning of mathematics in Grade 1 using tablets at a school in Mkhondo, Mpumalanga Province. This chapter will deal with the theoretical and conceptual framework plus the literature review, with reference to posthumanism and connectivism. Posthumanism is a theoretical framework that guides this study, where we look at the historical origins of posthumanism, its objectives and different forms of posthumanism. Furthermore, it presents the epistemology and ontology of posthumanism, the role of the researcher and the relations she has with co-researchers, and the importance of posthumanism in this study. Connectivism serves as the conceptual framework that directs this study. Important points will be presented concerning connectivism among others, connectivism history, connectivism learning environments, challenges and principles of connectivism, the role of the researcher, and its relevance to the study. It further presents the literature review relating to the main thrust of this study. The literature review will be structured by zooming in on challenges in using tablets, solutions, conducive environment, threats and risks. Included also will be the effective way of implementing the strategy of enhancing the learning of mathematics using tablets.

2.1 THEORETICAL FRAMEWORK

The theoretical framework in research is used to guide or lead the study (Varpio, Paradis, Uijtdehaage & Young, 2020:992). A theoretical framework serves as the lens through which the researcher views the world (Grant & Osanloo, 2015:12). It is a production of existing theories in the literature which has been legalised and verified to be effective in scholarly literature (Garvey & Jones, 2021:2). It further guides on the methods and theories that will help in achieving the objectives of the study (Maddax, Lu, Affinito & Gallinsky, 2021:346). In developing a strategy, this study uses posthumanism as a guiding theory in finding strategies to enhance the learning of mathematics in Grade 1 using tablets.

2.1.1 Historical origins of posthumanism

Posthumanism was developed by responding to the social and intellectual trends of the late 19th century and 20th century. Forlano (2017:9) states that posthumanism initiated friction in science in the 1970s. However, Koole (2020:1054), when revising Braidotti (2019), suggests that posthumanism developed from previous researchers' progressive knowledge systems of humanism. Forlano (2017:217) says posthumanism assimilates human and non-human establishments and technology. It is both an expansion and a distinction to the humanist mind. Posthumanism remains open to new ideas of doing things not governed by humanism (Koole, 2020:1054). It was developed through the roots of continental philosophy and critical theory responding to the Anthropocene in the 21st century (Effinger, 2022:2). The Anthropocene era is where humans governed the world with no respect to it, which led to many difficulties in the environment, socio-economic magnitudes of ecology, climate change, inequalities, technological advancements and social stratifications (Braidotti, 2018:13). The Anthropocene era is still visible even today, where many trees are cut down to create space for industries that pollute the earth, leaving humans with less oxygen producers, the floods and the COVID-19 and was the result of the people's greediness with no respect for the earth.

But posthumanism brings a shift. It comes as an antidote that reminds human beings of the connectivity they have with ecological systems, and this concludes that everything is entangled together (Jeong, Sherman & Tippins, 2021:810). Posthumanism's growth emerged from radical epistemologies and a reaction from humanist thought that placed the human at the centre of concern with specific historical situatedness, sociocultural structures and inequalities (Koole, 2020:1054).

Posthumanism is relevant to this study because it looks at a non-human gadget, namely a tablet, as an essential tool that could enhance the learning of mathematics in Grade 1, as posthumanism emphasises that humans alone cannot be functional except through relativity and the entanglement with non-humans.

2.1.2 Objectives

Posthumanism emphasises dualistic thinking and the human's dominant position (Dehnert, 2022:2). This then relates to the study because tablets do precisely what a

teacher does. Through mobile applications, a tablet can help in the teaching of mathematics and enhance learning.

Posthumanism is associated with decentring where the position of human is neither the human nor any other category which can be culture, ethnicity, religion or politics (Falcon, 2023:21). Posthumanism is relative to anti-humanism; it seeks to redefine limitations surrounding the present philosophical understanding of human (Ross, 2021:11). Anti-humanism focuses on fighting for social justice and how humans can promote a nearer association with nature (Ross, 2021:1). Therefore, as a theory of decentring and anti-humanism it relates to posthumanism. Hence, this study aims to decenter the traditional teaching method by employing non-human tools to work with humans to enhance the learning and teaching mathematics in Grade 1.

Barad (2003) uses intra-relationality, which highlights the drive and the forces in motion rather than directing to a particular individual body. Intra-relationality in posthumanism implies not focusing on a single aspect of learning but dependence on a wide range of educational categories (Du Preez & Simmonds, 2021:84). Relationality refers to how humans and non-human relates to each other. We are who we are because of the experiences we've been through. Similarly, learners' knowledge of mathematics will be influenced by how they were taught.

Posthumanism is anti-enlightenment. It says that humans are all different and should be treated equally; it stresses that people should not be treated according to their deeds as individuals but according to the deterministic role of people of ethnic, religious or cultural backgrounds (Ziegler, 2021:18). Posthumanism is anti-enlightenment as it encourages collaborative ways in all organisms, values the potential that each has for the betterment of present situations. Posthumanism has no concern for discerning changes between categories or refrains. Its aim is to realise entanglements and recognise the artificiality of the concepts. Thus posthumanism aims to entangle the use of human and non-human to overcome challenges (Muriss, 2020:37).

In conclusion, the objectives of posthumanism resonate well with this study, where all co-researchers are regarded as equal and essential in finding a strategy to enhance the learning of mathematics in Grade 1 using tablets.

2.1.3 Steps

Posthumanism believes in the central thought that says humans are important in research. It creates an illusion that a researcher can be separated in a study; instead, a researcher, co-researchers and objects are entangled (Maja, 2023:97). The use of the entanglement method is about not taking the human focus as the point of departure but as the interdependency of humans with non-humans. Teaching using technology brings a shift in what can be categorised as human; it elaborates that humans are not the only source of information (Hasse, 2020:5). Therefore, when applying posthumanism, we are to look at how teachers can utilise tablets to enhance learner's knowledge and attributes, we further look on how mathematical skills can be sharpened. This study identifies possible stakeholders: teachers, learners, technological gadgets and tablets. Then it investigates the stakeholders by engaging them in action research, gaining access to documentation, and learning about their attitudes, culture, interactions and interests (Gare, 2021:2). The next step will trace actions that lead to poor uses of tablets in enhancing the knowledge of mathematics.

2.1.4 Different formats of Posthumanism

Posthumanism is applied in different formats that are goal-driven and bridge the gap between humans and non-humans for the improvement of situations (Susen, 2022:64). With regard to the human and non-human forces that explore multiple subjects extending to multiple axes that include the trans-sex, trans-gender, trans-species, trans-corporeality and ultimately understood in a way as a product and a producer of the post-human condition, not in contradiction to post-anthropocentrism is how to view this phenomenon should be viewed.

The use of technology for advancement can reshape our self-understanding and our relationship with other species. During COVID-19, the increase in online learning bridged the gap in doing things, thus making the achievement of goals possible. The development of technology is seen to be increasing in all sectors, including education, the introduction

of robotics to teach, the upgrading of the curriculum to use technology, and the addition of the subject of coding in early grades.

The use of technology also advances even in less-affording communities through the provision of techno gadgets, Wi-Fi and more. Where previously community-based classrooms were created by those affording to benefit all, this encourages intra-relationality within communities. The root of extending humanity within the communities, nature and animals is mastered when these formats are appropriately applied.

Gladden (2018:40) describes diverse formats of posthumanism, categorised as synthetic and analytic, theoretical and practical posthumanism. Analytic theoretical posthumanism understands posthumanism as an actuality that already exists in the modern world, which needs to be analysed. Hence this study explores the effectiveness of tablets in enhancing the learning of mathematics, as they are portrayed as tools that can potentially increase performance when used. Synthetic posthumanism understands posthumanism as a gathering of hypothetical upcoming entities whose development can be internally understood or externally; different theories of teaching mathematics will be put to the test using tablets in this study. Theoretical posthumanism seeks to develop new information and understanding. This implies that successful developments in this study will be implemented to achieve effective results. Practical posthumanism seeks to convey social, political, economic or technological change. The tablets will enter the scene as the main change from the traditional way of teaching as they come with many resources that can be accessed through them.

The study depends much on the co-researcher's' input utilizing the tablet in developing the strategy of enhancing the learning of mathematics. Everyone contributes freely and effectively.

2.1.5 Epistemology

Posthumanism theory offers a new epistemology that is not anthropocentric nor centred in Cartesian dualism but seeks to find new methods of knowing and embracing the world's diversity (Gherardi, 2021:3). Posthumanism depends on both humans and non-humans

to develop strategies together through interdependence (Niccolini & Ringrose, 2020:5). This study also depends on both human and non-human to enhance the learning of mathematics. According to Talguer and Schank (2021:9018), the posthumanism approach rejects the traditional boundaries about humans as the only species to produce knowledge; instead, it creates other forms, objects or beings to generate information. Posthumanism is a radical expression in research that makes the borders between theory and method (Ross, 2021:9). It nurtures the progress of language by using approaches in research that focus on peer collaboration as relational practice formed through sharing and caring activities without bargaining ethics by engaging a practice-based approach to study (Gheradi, 2021:20). So is this study. It treats everyone involved with respect, not discriminating in any manner and treats every co-researcher with respect.

2.1.6 Ontological stance

Ontology in posthumanism refers to the way of thinking about things afar from humans and admitting other human beings as the only residents of this world (Fox & Alldred, 2020:123). It further challenges human authority and discernment but recognises other beings in the world. According to Mellström (2022:5), posthumanist ontology is intensely fixed in the relationality known through our being in the world and relations between humans, non-humans, and more than humans. According to (Ross, 2021: 11), ontology has to be understood as being associated with materialism and agency in posthumanism. A posthumanist performativity approach concerns understanding natural, cultural tendencies that expressly acknowledge and consider matters of vitality. Furthermore, posthumanism ontology forces one to think, observe, understand and use theories to practise humanity (Ross, 2021:12).

According to Díaz de Liaño and Fernández-Götz (2021:543), posthumanism suggests new ontological frameworks that challenge conventional Western metaphysics. Posthuman knowledge emphasises the relationality between human and non-human in one way or another (Anderson, 2022:396). Furthermore, it encourages continuity between human bodies, minds and tools that establish humanity's lengthy unit. This is useful in this study because it seeks ways of teaching the mathematics curriculum in a Grade 1

class in a method that is related to the present drift of life, where a tablet is not only for personal use but an essential gadget to everyone, and can be used for educational resolutions to enhance learning situations, making learning effective, easy and more enjoyable for learners.

2.1.7 The language/ rhetoric

The analysis of interdependence between humans and non-humans depends on all parties' performance to reach the main objectives of Posthumanism. A tablet, a natural setting, and knowledge of mathematics and its concepts form a non-human participant (Coles, 2022:218). The posthumanism framework analyses different actors' relationships and marks each productive influence on another (Ferri, 2020:412). Therefore, the interaction of actors in developing a strategy is monitored collectively, and together, they point out problems and then try to solve them.

Pursuant to this, the researcher found the posthumanism theory relevant for effectively using its framework to design a strategy to enhance the learning of mathematics in Grade 1 using a tablet.

2.1.8 The role of the researcher in Posthumanism

The researcher is seen as the leading partner in the research process. However, the focus is on posthumanism, where the research is relational to all involved in the process in several parts. We need to ensure that practices are respected, not hindering the society that is not engaged but stays within the researcher's (Hooks, 2020:2). In this study, the researcher's role will be to inform co-researchers about the research findings properly. Also, to ensure that the use of tablets as a form of involving the non-human in education and its effectiveness is entangled with co-researchers for future use. Furthermore, to organise co-researchers elaborating the primary goal of the research, all visible and hidden assumptions and their expected roles (Maibi, 2020:20). Also, encourage co-researchers on proactive involvement and explain that the success of this study depends on their effective participation.

2.1.9 The importance of posthumanism to this study

Posthumanism is relevant for this study because it relates perfectly well with the aim of the study, with its focal point being the interdependence between humans and nonhumans, better described as entire pollution and hybridization of human beings with other living beings and machines (Qhosola, 2023:35). Valera (2014:486) further explains that posthumanism comprehends technology as one of the means to reach a not-purely technology by embracing the interdependent relationship between technology and people. Posthumanism concerns the notion of social justice in education in its social and environmental form about the following themes: our technological essence, our bodily relationship to ourselves and nature, our relationship with the world and our relationship with intelligent systems (Peters, 2020:582). Posthumanism is significant to this study as it explains the importance of involving technology in a mathematics classroom; it further throws light on how mathematical skills can be well developed when proper utilization of tablets is applied (Hasse, 2020:148). Learners gain collaborative and problem-solving skills and learn to be creative and critical thinkers through software that enhances such skills. Posthumanism inspires the development of all participants involved. Therefore, teachers need to know these skills to be able to plan lessons, technological, and daily activities and create assessments that test skills at different levels of cognition (Qhosola, 2023:36). In addition, posthumanism makes it possible for humans and non-humans to bring information and together design a strategy to enhance the learning of mathematics.

2.1.10 The relationship with the researcher and co-researcher

According to Koole (2020:1054), the current technological revolution that is happening intensifies populism, militarism, anxiety and ecological disaster, which in many ways weighs much upon us psychologically and politically and spreads our fears to new dimensions globally and locally. However, Braidotti (2019:32) believes that posthumanism provides us with ways to relook into our existence as humans and look for ways to advance our capacity to move forward positively, as this study intends to examine the possibilities that a tablet could bring from the traditional way of teaching and enhance

the learning of mathematics in Grade 1. Koole (2020:1054) interrogates Braidotti's (2019), thinking about posthumanism and education and suggests that it can shape our education system positively if we submerge our posthuman thinking and our posthuman values into our curriculum as well as into the structure of our educational institutions.

I described the intentions of the study with co-researchers. The intention of the relationship among researchers is linked to posthumanism, which looks at all things valuable to produce information. To elaborate on the needs of the study group rather than pursuing the study individually, the researcher and co-researchers are essential to designing solutions. The study is conducted in a language that is understandable to all co-researchers, and ensures that the researcher and co-researchers are co-researchers in this study. As this study uses PAR, the researcher and co-researcher have equal influence. Everyone in the study is fully involved in learning and is not a mere observer (Dube, 2020:137).

2.2 DISCUSSION OF CONCEPTUAL FRAMEWORK

The connectivism theory guides this study as the conceptual framework. Connectivism is a theory concerned with understanding learning in a digital age, considering the internet and web browsers, search engines and online learning. Connectivism is a theory that suggests that learners must combine their opinions, theories and overall information to acquire learning skills (Thoma, Farassopoulos & Lousta, 2023:131). Furthermore, it accepts that technology plays a massive role in today's learning, with online classes, internet wikis and social media (Siemens, Rudolph & Tan, 2020:109). According to Maawali (2022:308), connectivism changes the learning environment, shifting the thought of only learning in classrooms and encouraging different places and ways to learn through online platforms. Maawali (2022) further argues that the connectivism theory fills the gap between learning approaches and resources.

2.2.1 What is connectivism?

Connectivism is a theoretical framework for understanding learning in a digital age, which indicates the emphasis that connectivism gives to technology's effect on how people live, communicate, and learn (Thoma et al., 2023:132). Boyraz and Ocak (2021:1122) define connectivism as an epistemological approach to learning that focuses on network communications in the individual's mind and the environment. Connectivism differs from other theories, such as constructivism or behaviourism, because learning is defined as actionable knowledge within the organization and is focused on connecting specialised information sets and connections that enable continual learning and the current state of knowing (Yu, 2021:2).

2.2.1.1 *Origins of connectivism*

This theory was first conceived by George Siemens between 2004 and 2005, who viewed traditional learning theories as inadequate and named it a theory of the digital age (Spinello & Corbet, 2020:3). The formation of connectivism was not influenced much by the rise of digital technology and is not a response to digitalization. However, it is still a way to use visions resulting from digitalization to address learning and development (Nazari & Niknejad, 2021:3). In 2007, Bill Kerr and Foster, at an online connectivism conference debated connectivism extensively, looking at its cons and pros. Furthermore, in the context of digital and e-learning, connectivism was recognised, and its technological inferences were discussed (Siemens & Ally, 2008).

2.2.1.2 *Learning in connectivism*

Learning in connectivism shifts the responsibility of teaching and mainly learning to learners, as most of the learning occurs on a technological gadget (Yu, 2021:3). Learning is stimulated and influenced by establishing and maintaining connections where old and information that is not needed is abandoned with only the new information to be learned and be linked with people for proper use (Corbet & Spinello, 2020:1). Furthermore, Yu (2021:1) says in connectivism learning settings and learners are directed and encouraged

to discover information on their own, can be online and share what they find with their peers using networks in their classroom.

Learning in a connectivism environment includes three cyclic phases: planning, cognitive processing, and evaluation (Dowes, 2022:1). Connectivism conveys a new height to learning where learning information can be retrieved through the selection of suitable technical material, suitable technology, design, and the use of laboratories and learning in actual circumstances (Corbet & Spinnelo, 2020:2). Learning using social media is also encouraged in connectivism, learners can create a group where they connect and share relevant information (Boyratz & Ocak, 2021:1125)

2.2.1.3 Challenges faced by connectivism

Different challenges occur regarding learning with connectivism. Connectivism requires learners to be independent since learning is self-directed. Without this skill, learning becomes tough without the supervision of an adult (Corbet & Spinnelo, 2020:3). Access to technology is another big issue for connectivism; it requires learners to have an essential technological gadget and access to the internet (Thoma et al., 2023:133). Boyraz and Ocak (2021:1127) claim that there are still gaps in the connectivism literature, which will affect practice reflections and leave them highly vulnerable to criticism.

2.2.1.4 Steps in applying connectivism

Connectivism, when used in the classroom, follows the following five steps (Yu, 2021:3).

1. The first step in connectivism theory in the classroom is to determine the teaching activities through planning. That can include planning of digital learning opportunities, online courses, webinars, social networks and blogs.
2. The second step includes explaining the knowledge points and identifying problems. This refers to the provision of the content summary of knowledge acquired by the teacher to learners to break down complex knowledge, possible challenges and diagnosis.

3. The third step is breaking into groups for a group discussion, this is the action phase where learners are expected to perform tasks, do practical work, and investigate knowledge trails and interests to extend their understanding of knowledge and solve real problems.
4. The fourth step is an extension exercise and observing if the previous steps were all implemented. Learners are given more complex exercises and tasks, expansive practical issues and extension exercises.
5. The fifth step is practice and reflection, where the acquired skill is implemented.

These conceptual framework steps are necessary for the study to follow in the classroom practice when applying the approach because they are in line with the day-to-day teaching of lessons.

2.2.1.5 Principles of connectivism

The Connectivism theory as a conceptual framework is closely related to posthumanism. Connectivism considers the fact that learning occurs in non-humans, which is a similar concern with posthumanism to say non-humans also bring learning (Bolter, 2016:7). The following principles guide connectivism:

- Learning and knowing reside in different ideas.
- Learning is the process of connecting specific circuits and knowledge.

Connectivism, as a learning theory, is founded on the idea that learning can occur outside of the classroom through knowledge that is found across a network of connections, the understanding that decisions may change due to rapidly altering foundations, and the notion that information is continuously generated and acquired (Downes, 2022:59). According to Downes (2022), connectivism is a learning theory that offers an experiential foundation for understanding teaching and learning by redefining how we view knowledge, how learning occurs, what we are trying to achieve when we learn, and how learning is communicated and evaluated, rather than necessarily being treated as an alternative learning theory with which to interpret phenomena (Downes, 2022:59).

2.2.1.6 *The role of the researcher in connectivism*

The role of the researcher in connectivism learning is to create a learning podium and context that helps learners develop their learning environments through network connections (Yu, 2021:3). The researcher needs to look for suitable applications and verify them empirically in the teaching process (Pecina & Marinic, 2021:7978). In connectivism learning environments, learners are more active than teachers. Self-discipline and control are essential as networks carry many things that could harm a child or waste time. The researcher must appreciate the learners' situation and provide targeted guidance (Yu, 2021:3).

2.2.2 Relevance to the study

This study uses tablets to find a strategy to enhance the learning of mathematics in Grade 1. Connectivism is relevant in this study because it supports the idea that knowledge is no longer limited to school facilities, teachers and infrastructure. Still, technological tools like the tablet can also help to enhance learning anywhere.

2.3 RELATED LITERATURE

This section looks at the relevant literature from local (South Africa), national (Mauritius), and international (Singapore) sources, with the intention of drawing best practice. Literature is reviewed concerning the objectives of the study, which are challenges, possible solutions to challenges, conditions conducive to the strategy, possible threats and evidence of success.

2.3.1 Challenges towards the enhancement of learning mathematics using tablets

2.3.1.1 Challenges of lesson plans that integrate learning outcomes without using a tablet

To teach using technology can enhance learning, but the teacher must adequately implement this, possessing quality cognitive knowledge and pedagogy. Lesson planning

that integrates tablets was found difficult to implement by teachers in Singapore. They complain that it does not allow them to do fundamentals in a mathematics class of Grade 1, especially allowing learners to be hands-on during the explanatory phase of the lesson. It could be using geo-boards when learning shapes, a play store to practise money skills and rolling dice to learn about place value (Tan & Chua, 2021:210). For the Foundation Phase, learners mostly understand when they can touch (Concrete) and see (Pictorial) before processing the knowledge as abstract. Usually, the lesson plan that uses tablets does not allow teaching within these steps (Fan, Fan & Cheng, 2021:2316).

Teachers in Mauritius complained that compiling a lesson plan that integrates well with tablets requires a lot of time. In most cases, it does not allow them to incorporate mathematics games during the exploration phase of the lesson, especially those that are kinaesthetic like math hopscotch which cultivate skills of making equations through drawing of squares (Khodabocus, Bahadur & Armoogum, 2022:40). Teachers also mentioned that they are not able to use games that are installed in tablets to integrate well with their lessons. Instead, they allow a student to play any games as they do not know how to integrate them (Oojorah & Udhin, 2022:105).

Teachers in South Africa were not able to integrate the lesson plans with tablets, mainly in the engagement phase, where a teacher aims to focus attention on learners, maybe explaining the lesson outcome, or in the introduction, perhaps using prior knowledge for example, “who is the tallest in class?.” This is teaching at length (Torres & Giddie, 2020:118). Integrating lesson plans when teaching service learning was also challenging in South Africa. For example, when learning data handling, learners pick garbage in a community park as a form of service to clean the community, then come with that garbage to analyse data in class. Hence, integrating this lesson plan into tablets was difficult for teachers (Ramsaroop & Petersen, 2020:3).

The advancement of traditional classes to technological classes involves using digital lesson plans that correlate well with technological gadgets used in that classroom. Therefore, Grade 1 mathematics teachers should be able to create and use digital lesson plans.

2.3.1.2 Challenges of knowledge-building and facilitation not using tablets

In a mathematics class, knowledge-building is essential as it emphasises that learners should produce more than what was learned on all concepts so that they can use it to solve problems.

Research in Singapore demonstrates that physical knowledge-building was not well enhanced through using tablets as many learners could not analyse the given data, for example, given different weather degrees and be able to interpret and analyse it (Larkin & Lowrie, 2022:48). Furthermore, the skills in social knowledge were not well developed by using tablets in Singapore, learners still struggled with describing or comparing two-dimensional shapes in terms of straight sides and round side (Li, Lou, Zhao, Zhu, Ma & Liao, 2022:10333).

Meanwhile, in Mauritius learners could not perform well when building logical knowledge using tablets in activities that required them to synthesise and evaluate information, for example, given a sum to evaluate given data and draw a graph with estimated information (Olivier, Oojorah & Udhin, 2022:5). On the other hand, the application of conceptual knowledge was not enhanced by tablets as learners could not link prior knowledge with new concepts taught, for example linking number abstracts when adding mostly requires pictures to solve (Flore & Govender, 2021:888)

Similarly, tablets could not increase learners' social knowledge in South Africa, especially in two-dimensional shapes. For the learners to be able to draw 2D shapes, they must understand the properties of these shapes. For example, a square has equal sides and teachers lacked skills to develop this kind of knowledge using tablets (Govender, 2021:33). Again, tablets were not able to help teachers develop physical knowledge in learners where they develop skills to gather information on basic academic lessons, playing with toys and learning abilities and techniques to be used in solving life challenges (Saal & Graham, 2023:3).

Knowledge development in mathematics Grade 1 is essential as it helps learners to develop content skills that will be useful even in future grades.

2.3.1.3 Challenges on assessment without using tablets

Assessment is an essential part of teaching where teachers get the opportunity to examine the effectiveness of their education. As classes advance to technology, tablets are necessary; teachers must create assessments that align with the curriculum.

In Singapore, studies show that teachers were not able to create a meaningful and purposeful assessment using tablets; in most cases, when assessing as in tests levels were in low order, which only tested a few skills, not as required by the education curriculum (Chan, Bista & Allen, 2021:5) for example “what is this number 5”. According to Attard et al. (2020:326), the creation of assessment using tablets dwelled much on routine questions and ignored the other cognitive levels, which resulted in learners mastering only a few aspects of the mathematics levels and made it difficult for teachers to determine the levels of understanding of learners of mathematical concepts and processes.

Meanwhile, according to Flore and Govender (2021:886), In Mauritius teachers were not able to track learners’ performance as they were not able to assess the processes of doing the tablets and only allowed them to determine the answer. This affects teachers as they need to know where their learners are weak in mathematics. Furthermore, according to Oojorah and Udhin (2022:105), assessment using a tablet could not allow teachers to repeat the evaluation to get valid results when assessing patterns using colour beads to a learner who is having visual perception problems. This makes assessment by teachers invalid.

Meanwhile, in South Africa, teachers still preferred writing tasks on paper instead of making them interactive assessments. They wanted to assess learners in various settings and use different methods, which they could not do with a tablet (Roberts & Porteus, 2023:342). Roberts and Porteus (2023) further state that some teachers who assess learners on tablets complain about difficulties of managing learners' progress and giving feedback. On the other hand, some teachers could not determine the total number of learners using tablets, especially in counting. For example, a learner's count from one to ten rote counting is perfect, but when given blocks to count he struggles. Teachers

experienced some difficulties in assessing the learner as a whole in such activities using tablets.

2.3.1.4 Challenges to collaborative learning and participation not using tablets

Cooperative learning has many advantages as it allows learning to occur anywhere, whether in groups, with peers, or online. However, some challenges affect this magnificent way of learning. Many obstacles to collaborative learning have been widely researched.

Research in Singapore highlights the failure of collaborative learning using tablets, especially in groups. Learners complained about some group members who are distributive during lessons, some members are sponging, slack and contribute nothing, which results in group quarrels (Näykki, Isohätälä & Järvelä, 2021:4). In other groups students are not able to complete their work as they have to communicate with members only when they are online. If they are not tasks are not completed on time.

Similarly, in Mauritius social challenges were emostly captured when implementing collaborative learning on tablets. Communication skills were most problematic as they they did not share roles equally (Appavoo, 2020:80). The student groups became less cooperative and not collaborative as learners chose to do tasks individually, something that was not helpful to those needing help (Sarah, Amine & Jinot, 2023:2). In most cases, learners in Mauritius felt isolated by their peers during collaborative learning using tablets. In some situations, they were discriminated against primarily due to gender (Sarah et al., 2023:3).

South African schools reported that learners were not able to use tablets correctly to access textbooks that are installed within the tablet, primarily when they viewed them as requiring a specific application to open, which was not relevant to them (Masango et al., 2022:2). The members were not placed well according to their abilities as it is required that on collaborative learning groups should be mixed so that learners can help one another (Jojo, 2023:177). Jojo (2023:178) furthermore says that proper maintenance of discipline during collaborative learning is essential; learners in South African classes were seen as disturbing, making it challenging to achieve collaboration.

2.3.1.5 Challenges with teaching involving real-life situations without using tablets

When teaching Grade 1, it is essential to explore real-life situations daily, as mathematical skills help solve real-life problems.

In Singapore, teachers cannot integrate the use of tablets when teaching number patterns. They usually use learners to demonstrate, and they find it challenging to implement this strategy using tablets, for example, the relationship between the number of learners and the number of hands. Tables play a big role in teaching patterns. Also, teachers find it challenging to derive real-life situations to draw a table using a tablet.

In Mauritius, teachers could not teach fractions as most learners make sense of fractions when experiencing hands-on teaching. Now, teachers were not able to demonstrate this using a tablet. For example, sharing sweets equally is called fair sharing. Research says that when teaching fractions in Grade 1, teachers should not be involved in any formal computation with fractions and have no agency to introduce symbols quickly. Therefore, applying more practical teaching of fractions in real-life situations is essential to build concrete knowledge of these concepts.

In South Africa, we could not apply real-life situations using tablets when teaching measurement, especially length. Teachers find it challenging to integrate tablets as they usually involve learners by using tape measures to measure one another or the length of their desks, books or objects in class (Du Plessis & Letswene, 2020:72). They also experienced difficulties in teaching mass content of measurement as they used to bring empties from home. There was the comparison of grams and kilograms in relation to objects. Learners related well with those as they see them daily in their homes and were able to grasp well, but the integration of tablets in this content was complex for these teachers (Tsakeni, 2021:3).

2.3.2 Solutions for challenges

2.3.2.1 Teachers cannot create lesson plans that integrate lesson outcomes with tablets.

As the world embraces technological advancements in education, transitioning from traditional learning methods prompts educators to enhance their skills and adapt to new teaching and lesson-planning approaches. Singapore, a pioneer in innovative learning, has diligently worked on developing teachers' abilities to plan lessons incorporating technological tools. This commitment extends to tertiary education, where educators have the necessary skills (Nikolopoulou, 2022:105).

In Mauritius, experienced teachers face challenges in planning lessons that involve tablets. Despite intensive development programs, some teachers use tablets sporadically, perhaps once a week (Appavoo, 2020:358). The training initiatives for teachers in South Africa have not yielded significant improvements, with many workshop attendees still struggling to plan lessons involving tablets. However, a slight improvement is observed among newer and younger teachers (Graham, Stols & Kapp, 2021:200).

2.3.2.2 Knowledge-building and facilitation not using tablets

Using tablets, Singapore has implemented various strategies to enhance knowledge-building in Grade 1. Employing visuals, particularly in counting, addition, and subtraction, proved successful as teachers observed increased knowledge acquisition when concepts were explained with pictures. The curriculum was developed to incorporate STEM, contributing to the development of mathematical knowledge in learners (Li et al., 2022:10333). In addition, mathematical games, including quizzes on number patterns and ordering, were designed to build conceptual knowledge further among Singaporean learners (Muchmud et al., 2021:25).

In Mauritius, the curriculum was adapted to facilitate knowledge-building teaching using tablets, incorporating applications that teach multiplication and reinforce the concept until mastery is achieved (Appavoo, 2020:359). Basic mathematical skills are taught through engaging games that encourage learners to apply various mathematical concepts such

as number concepts, addition and subtraction, allowing them to develop skills they do not possess (Olivier et al., 2022:5).

In South Africa, tablet-installed worksheets were created to serve as remedial work for learners, aiding in developing knowledge of previously learned mathematical concepts. These worksheets test learners' abilities to synthesise and apply knowledge in 2-D shapes, counting and number patterns up to 100. The establishment of organizations such as JumpStart has contributed to community classes where learners use tablets to intensify their mathematical skills, focusing on areas such as number operations, multiplication and time (Roberts & Porteus, 2023:338).

2.3.2.3 Creating assessments not using tablets

Effective teaching is shown by the results that students acquire, and it is crucial to know how to create assessments to test learners. The involvement of STEM in Singapore made it faster for teachers to develop assessing skills using tablets, as STEM provides assessments to learners, which test skill levels and increase the strength of questions as the learners' knowledge increases (Gozum, 2022:490). Using digital games is another way to assess learners' mathematical skills in Mauritius. These games have levels of beginner to most skilled and test skills on basic mathematical content, mostly in a quiz form (Aksoy & Belgin Aksoy, 2021:4). According to Sibanda and Rambuda (2021:301), it is not effortless to create formal assessments for early graders using tablets in South Africa as this requires all learners to be fully equipped with tablets. Still, informal assessment can be achieved in classes where learners can share tablets and try to solve problems collaboratively.

2.3.2.4 Collaborative learning and participation without using tablets

Collaborative learning has always been promoted in the education sector, but its popularity soared during the pandemic when its necessity became more pronounced due to the absence of physical classes. Tablets proved instrumental in facilitating collaborative learning in Singapore, irrespective of the learners' locations (Tay, Lee & Ramachandran,

2021:300). The establishment of online classes enables learners to actively solve mathematical problems with their peers or with the teacher's guidance. This is achieved by organizing virtual meetings or exchanging messages, even though voice notes on platforms like WhatsApp are also used. Through these methods even in Mauritius, learners remain actively involved in the learning process even in the teacher's absence (Sarah et al., 2023:2). In South Africa collaborative learning enhances communication skills, as learners share their views through voice or written communication, making it easier for teachers to identify areas where learners may need further refinement (Jojo, 2023:179).

2.3.2.5 Challenges with teaching involving real-life situations without using tablets

Using tablet cameras proves valuable in Singapore, where learners can capture images of materials at home while studying mass, various 2D shapes or 3D shapes, allowing them to relate concepts like sliding or rolling to their daily experiences (Nikolopoulou, 2022:105). Tablets are also successful in problem-solving, especially when dealing with picture-based addition or subtraction problems, puzzles and activities involving grouping and sharing, such as distributing sweets among friends.

In Mauritius, tablets have been effective in teaching fractions through instructional videos. These videos may feature scenarios like sharing pizza pieces or dividing an orange, allowing learners to interpret the total number of pieces and the share each child receives (Perienen, 2020:1845). Puzzle activities on tablets, incorporating relevant pictures, have also proven successful in reinforcing skills related to ordering numbers, addition and subtraction. These puzzles only fit when the correct answer is chosen, requiring learners to apply mathematical skills to solve the problems (Bhaugeerutty, 2021:50).

In South Africa, teachers have developed strategies for teaching length using tablets by incorporating photos or videos. Learners interpret images to identify long trees or short pencils, applying skills in comparing length-based pictures (Khosa & Molotsi, 2020:299). For mass-related concepts, videos are used to compare the weight of objects, such as a

seesaw video game, enabling learners to synthesise their knowledge of mass in real-life situations (Chikiwa & Ludwig, 2023:135).

2.3.3 Conducive conditions that ensure effective use of tablets to enhance the learning of mathematics

2.3.3.1 Conducive conditions for teachers who cannot create lesson plans that integrate lesson outcomes with tablets.

Effectively teaching mathematics with a tablet requires educators to possess diverse skills in tablet usage, familiarity with various applications, and an understanding of their alignment with the Grade 1 mathematics curriculum. In Singapore teachers play a crucial role in creating conducive conditions for learning by selecting relevant apps aligned with the curriculum and incorporating diverse activities covering all mathematical content. Lesson effectiveness is contingent on well-planned lessons, and teachers capable of creating comprehensive lesson plans involving tablet use contribute to smooth and disruption-free learning experiences (Muchmud et al., 2021:83).

Recognising the significance of effective teacher development, Singapore prioritised equipping teachers with essential e-literacy skills. In Mauritius, professional development was considered crucial, and teachers preferred practical online training over written instructions (Flore & Govender, 2021:888). Conversely, South African teachers received limited development with insufficient follow-up, impacting their capabilities (Diseko, Nyamande & Kuhudzai, 2022:16).

2.3.3.2 Conducive conditions on knowledge-building and facilitation without using tablets

Knowledge-building in mathematics comes as a fundamental procedure to be developed. It results in learners being able to apply these knowledge techniques to different learning outcomes. In Singapore, the use of the STEM programme improved much on building knowledge, emphasising that all learners are able to access knowledge regardless of their environmental condition or affordability (Teo & Choy, 2021: 45). Conditions were made conducive in Mauritius through creating a variety of applications, provision of tablets and access to Wi-Fi by all learners (Oojorah & Udhim, 2022: 110). The South African

education department improved conditions by providing tablets to learners, installing relevant applications and providing textbooks (Hardma & Lilley, 2023: 322).

2.3.3.3 Conducive conditions on creating assessment using tablets

The assessment of learners serves as an indicator of teaching effectiveness. Therefore, designing formal or informal activities using tablets is imperative for educators in innovative classrooms. In Singapore ensuring that these activities test various cognitive levels in learners is essential (Attard et al., 2020:350). In Mauritius, assessment conditions were improved by creating applications that assessed the curriculum and learning objectives directly. Many attempts were tried in developing these assessments - until they were suitable for the conditions in Mauritius (Perienen: 1). In South Africa monitoring the progress of learners' knowledge in selected content activities, whether through apps like IXL, Maths Magic, or others, is crucial for both teachers and parents (Lenhoff, 2021:3).

2.3.3.4 Conducive conditions on collaborative and participation without using tablets

Encouraging collaborative learning through tablet use allows learners to engage in group activities, teaching, communication, and problem-solving, fostering motivation and skill development. Singapore education prioritises safety, restricting access to harmful information, spyware, and excessive exposure to social media when using tablets to ensure a healthy learning environment (Shwin & Lwin, 2022:311). Similarly in Mauritius, groups were guided by teachers to enforce focus, as it was seen that when learners were learning collaboratively, the main focus shifted to collaboration and learners tended to do something else (Appavoo, 2020: 74). In South Africa, most of the social media applications were prohibited as many learners seemed to focus on entertainment rather than on learning. Only a few applications were used to communicate during collaborative learning (Kolobe & Mihai, 2023: 109).

2.3.3.5 Conducive conditions in teaching involving real-life situations without using tablets

In Singapore, conditions were improved by relating mathematical content to real-life situations - especially measurement. Learners were given activities they were familiar with for better understanding. For example, measuring flour during baking (Yeo, 2021:304). Meanwhile, in Mauritius activities on tablets were developed to align with learners' daily routines for their better understanding (Appavoo, 2020: 78). Furthermore, in South Africa the use of indigenous languages and objects helped to better the conditions of learning mathematics in Grade 1 (Govender, 2023: 147).

2.3.4 Anticipated threats and how to circumvent them when using tablets for teaching and learning of mathematics

Possible threats that may be caused by using tablets in learning mathematics can be unwanted and harmful content that learners can be exposed to.

2.3.4.1 Threats in creating lesson plans that does not integrate tablets

In Singapore, the most fascinating threat on lesson planning that did not integrate tablets was that teachers would not use tablets to achieve mathematical objectives, but would instead use them as a means to keep learners busy, or for them to play with (Sahal & Ozdemir, 2020: 28). Similarly in Mauritius, teachers that did not have lesson plans that integrated tablets tended to ignore the use of tablets in class. Instead they gave learners homework to do on tablets – but the topics did not align with what was taught in class (Ramjaun, Atchai & Reiss, 2023: 1130). In South Africa, teachers seemed to lack confidence in using lesson plans that integrated tablets. They referred to tablets as time wasters, simply because they lacked knowledge on how to create lesson plans that integrated tablets (Nadioo & Hajaree, 2021: 1).

2.3.4.2 Threats in building knowledge and facilitation without using tablets

Singapore had threats in building knowledge with tablet applications that did not integrate outcomes of learning mathematics - the fear was in building knowledge on aspects that were not projected for the Grade 1 mathematics curriculum (Nikolopoulou, 2022:105). In Mauritius, threats in building lower order knowledge on tablet applications were effective.

But they stimulated learners' thinking capacity at a low level (Zhai & Pellegrino, 2023: 1046). Furthermore, in South Africa teachers viewed applications that dwelt only on a few content topics – those that carried low weights in the Grade 1 mathematics curriculum (Smith, 2023:1).

2.3.4.3 Threats in creating assessment without using tablets

Learners in Singapore were able to search or use calculators in sums that needed to test their critical and creative thinking. However, this resulted in an unstable performance of a learner's performance in mathematics (Chan, Looi, Ho & Kim, 2023: 2037). Similarly, in Mauritius, game-based assessments resulted in learners predicting answers as they mostly came in the same pattern. Teachers were afraid that learners would not show exact results as they guessed answers, not using any proper application of skills taught (Connectivities, 2021: 575). In South Africa, teachers were not ready to assess learners using tablets – they felt that this took more time. It was difficult to generate questions that correlated with the curriculum and integrated the use of a tablet. They feared not being able to assess on time and not getting required outcomes (Zulu, Haverly & Reddy, 2020:15).

2.3.4.4 Threats in collaborative and participation without using tablets

Singapore research states that digital or mobile tools in the classroom bring unwelcome conduct and engagements if learners are not appropriately supervised, and this might lead to numerous physical, psychological, and social threats (Viberg, Andersson & Wiklund, 2021:22). Meanwhile, in Mauritius the internet challenges appear as threats to hinder the proper utilisation of tablets, especially when learners are home (Oojohar & Udhin, 2022: 118). Furthermore, in South Africa the incapacity of parents to buy tablets for children becomes a threat for learners without which they will be left behind and not get enough practice as they will not be able to do given work (Saal & Graham, 2023:6). The price of tablets can be very high. Their life span is concise, considering the grade we are working with. If by mistake it falls, and the screen is easily damaged, that will add costs for parents.

Other threats are the issues of signal and electricity, where most learners do not have access to Wi-Fi except only at school. Thus conducting online classes when at home or sending work using email or any app becomes a challenge to download unless parents buy data. In most rural areas, when there is loadshedding the signal does not work and that could also be a threat. (Marongwe & Garidzirai, 2021:216).

2.3.4.5 Threads in teaching involving real-life situations without tablets

To teach mathematics involving real-life situations without using tablets in Singapore became a threat - as most of their mathematics curriculum focused on events common in the daily lives of learners. It seemed that teachers could not enable perfect absorption of the content as they are not familiar with how to do this using a tablet (Harris,2020: 1). Meanwhile, in Mauritius teachers feared that learners would not easily remember content taught as it was not familiar with them (Zhai & Pellegrino, 2023: 1048.) Similarly, in South Africa, most curriculum content was taught through indigenous activities and games, like hopscotch. The use of tablets for teaching about events that did not integrate any real-life situations brought fear into teachers. They lacked proper understanding of the curriculum, especially on the abstract phase of teaching mathematics (Ramolumo & Mohapi, 2023: 77)

2.4 SUCCESS INDICATORS OF THE STUDY

The success of this study will be measured by the effective development of teachers, equipping them with specific skills to enhance Grade 1 learning of mathematics through the use of a tablet, including aptly selecting applications to foster creative and critical skills in mathematics content.

2.4.1 Creation of lesson plans that integrate tablets

Successful outcomes involve teachers' capability to create comprehensive lesson plans that incorporate tablet usage, facilitate learning through tablet presentations with

interactive features, and encourage learner participation. Teacher development in using tablets for re-occurring developments (whether online or physically) would result in the success of the study. Technology and ways of doing mean change, so teachers need to be in touch with new methodologies.

2.4.2 Building knowledge and facilitation of the use of tablets

Success in building knowledge and facilitation will be shown by the selection of correct tablet applications that integrate the Grade 1 mathematics curriculum. Teachers should be able to use tablets in the facilitation and building of projected learning outcomes for mathematics.

2.4.3 Creating assessments that integrates tablets

The success of the study depends much on teachers being able to create assessments using tablets, acquiring skills and developments on how to administer questions on tablets. Another success will be the ability to choose specific assessments to test specific outcomes, and making sure that they reflect each learner's own work. Applications that allow feedback to be done for re-enforcement should be used. Lastly, the assessment tasks should test all levels of cognitive development - from lower order to higher order thinking levels so as to stimulate learners.

2.4.4 Collaborative learning and participation using tablets

The study's success is further evident when learners collaborate and assist one another in solving mathematical problems, emphasizing the development of communication skills through collaborative learning. Successful assessment practices in tablets, encompassing formal and informal methods, enable teachers to efficiently grade, track progress, and provide valuable feedback to learners. In addition, the study acknowledges success in mastering settings that prevent learners from accessing harmful content and ensuring that tablets are exclusively used for educational purposes, not for personal use.

2.4.5 Teaching involving real-life situation using tablets

Success of the study will be the development of teachers to be able to use tablets in activities that involve real-life situations. Real-life situation activities help learners to associate mathematics with what they do daily. Therefore, if teachers are able to select

activities on applications that have real-life situations, that would indicate the success of the study.

In conclusion this chapter discussed insights from literature about challenges, solutions, conducive conditions, threats and the success of the study. It funnelled the most common challenges that affected selected countries and further informed this study about these challenges. Furthermore, it sought to encourage stakeholders in the education system to recognise and appreciate the significant role that tablets can play in enhancing Grade 1 learning of mathematics.

CHAPTER 3

RESEARCH DESIGN AND METHODOLOGY

3.1 INTRODUCTION

This study aims at devising a strategy for improving the learning of mathematics in Grade 1 using tablets at a school in Mkhondo. The initiative stemmed from a realization during teachers' meetings at the school that there was a need to enhance the teaching of mathematics with the integration of tablets. I became involved in leading this process after receiving an invitation from my colleagues. Participatory Action Research (PAR) was the chosen research approach to pursue this goal. It is to be noted that the school is situated in a rural setting with a disadvantaged socio-economic background.

Permission was sought from all co-researchers (participants) through signed letters of consent and assent, clarifying that their participation was voluntary and they could withdraw at any point if they felt uncomfortable. The request for video and voice recordings was explained, permission was granted and pseudonyms were utilised to safeguard the co-researchers' identities. Subsequently, teams were formed consisting of a steering team with four members responsible for day-to-day implementation, supported by a larger team involving everyone.

The team members' credentials were discussed, and various roles were assigned among the co-researchers. A SWOT analysis was conducted to evaluate the team's strengths in alignment with the vision, identify weaknesses that could impede success, explore opportunities, and assess potential risks in achieving the vision. Thereafter, five priorities were identified as the basis for a strategic plan. The plan outlines specific activities for each priority, designates responsible individuals or groups, identifies resources required for each activity, establishes a timeframe for completion and outlines the monitoring process. Emphasizing its collaborative nature that encourages the active involvement of all.

This chapter introduces PAR as the chosen research method co-researchers and the researcher can collectively use in devising a strategy.

3.2 HOW DID WE GET INVOLVED?

3.2.1 The role of the researcher

This initiative originated during a school meeting where the analysis of results revealed unsatisfactory mathematics performance. In response, the school decided to address the issue. It approached me to lead the research process in collaboration with them to develop a strategy for enhancing mathematics through tablet use. In this research endeavour, the researcher and co-researchers were responsible for identifying challenges, gathering information, analysing data and reflecting on findings. Mutual respect is emphasised, fostering an environment that encourages freedom of expression and allows for role changes within the team to ensure everyone's active participation.

The researcher served as the coordinator, responsible for organizing the team of co-researchers engaged in the study. The co-researcher team consisted of four Foundation Phase teachers, the school's Head of Department (HoD), the principal, the circuit manager and the Foundation Phase mathematics curriculum implementer. The collaborative working dynamic is maintained by ensuring control and commitment within the team. In contrast, the researcher provides a safe space for co-researchers to voice their opinions and concerns freely.

3.2.2 The relationship between the researcher and co-researchers

The collaboration between the researcher and co-researchers was founded on mutual respect and trust, fostering an environment where each party is regarded as an equal partner. This manifested itself through active engagement of both the researcher and co-researcher in identifying challenges, devising solutions and successfully implementing them collaboratively (Dlamini, 2018:89). Participatory Action Research (PAR) aims to decentralise the research responsibility, emphasizing the importance of ideas from all involved, particularly those directly impacted by the issues at hand. In PAR, researchers set goals and gather knowledge from those directly affected, leveraging their experiences and skills to formulate effective solutions.

3.3 PARTICIPATORY ACTION RESEARCH (PAR) AS A RELEVANT APPROACH

PAR empowers the researcher and co-researchers to identify problems, gather information, and devise solutions collaboratively. This study focused on developing a strategy to enhance Grade 1's learning of mathematics using tablets with contributions from parents, teachers, learners and all co-researchers. PAR engages ordinary individuals concerned and affected by a problem, encourages collective efforts to find suitable solutions and bring about social change (Choane, 2021:79). In PAR, the knowledge individuals have is respected and considered valuable thus fostering mutual learning among co-researchers.

PAR champions cooperation and pays close attention to marginalised or disempowered groups, prohibiting discrimination based on culture, age, ethnicity or religion. It advocates social justice by treating isolated individuals respectfully and considering their perspectives without bias (Tubtimcharoon, 2021:296). Therefore, PAR is relevant to this study as it enables everyone willing to contribute to positive change in the learning of mathematics using tablets to participate by combining the expertise of academic professionals with the lived experiences of those involved. Furthermore, it will help in engaging everyone involved in finding this strategy to have input and be able to implement it in different schools in Mkhondo or in the region.

3.3.1 Historical origin of Participatory Action Research (PAR)

In the 1940s, Kurt Lewin pioneered action research, developing participatory action research (PAR). Initially employed in psychology, PAR found its way into education through the work of Paulo Freire in the 1970s. In 2001, Solomon and Flores advocated openness and trust among co-researchers to facilitate collaborative research. PAR emphasises that those directly affected by a problem are well-equipped to generate effective solutions. Researchers in PAR should collaborate with affected individuals, avoiding imposition of their ideas and fostering diverse methods for problem-solving. Employing a participant-centred approach, PAR relies on the involvement and first-hand

knowledge of those impacted. Consequently, co-researchers can implement well-suited and feasible solutions, given their active participation in the solution-finding process.

3.3.2 Objectives of Participatory Action Research (PAR)

The primary goal of PAR is to generate knowledge through practical engagement and firsthand experiences. PAR promotes collaboration among those affected, fostering a deeper understanding of concepts through personal experiences. Moreover, PAR ensures that acquired knowledge is implemented to bring about social change for individuals and promotes the knowledge sharing within the community or organization. Similarly, PAR is focused on transforming co-researchers in both social and individual aspects, encouraging the practical application of the gained knowledge. In the context of this study, the aim was to devise methods for improving the learning of mathematics in Grade 1 through the use of tablets (Choane, 2021:67).

3.3.3 Formats of Participatory Action Research (PAR)

There are different formats of PAR depending on the goals that must be met. The purpose of Feminist Participatory Action Research (FPAR) is to bring structural change in systems for marginalised women to take part in or change their communities or the organizations they live in by being part of actions or bringing knowledge that produces change. Community-based Participatory Action Research (CBPAR) is done by people directly affected by a particular condition or issue; they work collaboratively and try to find a solution.

3.3.4 Steps and stages in Participatory Action Research (PAR)

Research using PAR as a method begins with planning, problem diagnosis, action phase, observation and reflection (Lenette, 2022:15). The first step is planning to enhance the learning of mathematics using tablets and involves challenges that limit teachers' ability to improve the learning of mathematics (Goessling, 2020: 5). The SWOT analysis,

processing, observation and reproduction then followed. The research team was fully involved in finding solutions to challenges.

3.3.5 Epistemological stance of Participatory Action Research (PAR)

Epistemology, the philosophy of knowledge, essentially explores how knowledge is acquired or, in simpler terms, how knowledge is attainable. In PAR, epistemology is constructed through the experiences and lives of individuals, shaping the perspectives of both the researcher and co-researchers. In PAR, the emphasis lies in implementing actions rather than just gathering information and leaving it at that.

Co-researchers were crucial in defining the problem, participating in data collection, and analysing information to identify potential solutions. The identified solutions underwent further research to assess their implications, and a continuous cycle of data collection, reflection, and action was maintained to enhance the situation. PAR promotes power-sharing among co-researchers, rejecting hierarchies and fostering a collaborative research environment. PAR empowers individuals to improve their lives and reach their full potential by offering liberation and freedom.

3.3.6 Ontological stance of Participatory Action Research (PAR)

The ontological stance of PAR is based on how teachers, learners and parents interpret the situation they face in their environment. PAR encourages learning in the emancipatory setting where co-researchers can gain new knowledge that helps them in their situation as they are practically involved in finding solutions; it aims to produce knowledge to help those directly affected by practical experiences and decision-making (Diaz-Arevalo, 2022: 346). Therefore, self-development, practical action and transformation are promoted in this project. The researcher is not detached but is a committed participant, facilitator and student.

3.3.7 Rhetoric language of Participatory Action Research (PAR)

The rhetorical language in PAR doesn't allow co-researchers to be treated as objects and left out. Still, it aims to develop marginalised people by emphasising practical action, social justice and access. Co-researchers were allowed to grow by participation, where they identified their challenges and sought solutions they could own and implement independently. To ensure that everyone in the team communicated at the same level, co-researchers used IsiZulu as it is stated that when you want success in any project, people must express themselves in a language they can understand. PAR has shown its significance in the classroom with regard to improving social conditions.

3.3.8 Challenges of Participatory Action Research (PAR) as a research method

There are several challenges in using PAR as a research method; the most common one is the inclusion of community members in a research team, something that can waste their time as PAR requires much time to be implemented (Smith, Mansfield, Wainright, 2021: 436). Furthermore, community members have different beliefs and abilities that can bring challenges if they do not understand one another. The stipulated time frame might not be reached, and conflict may arise when analysing and interpreting when irrelevant questions are asked. The inclusion of learners may cause trouble if it goes against their learning or adds much strain to their current work.

Moreover, power dynamics among participants affects the full expression of ideas, especially when the study involves respected individuals of the community. Some co-researchers are not comfortable to state their views freely (Vaughn & Jacquez, 2020: 1).

However, such challenges were monitored in this study by maintaining the focus of achieving the perfect strategy for our school; by making sure that everyone is accommodated - but being aware of the importance of time. The study also encouraged co-researchers to respect all beliefs and to try to work together to attain a successful strategy.

3.3.9 Success indicators of Participatory Action Research (PAR)

PAR encourages teamwork and the performance of every co-researcher with total commitment. It also enables all the team members to be responsible and take ownership of fixing challenges, implementing solutions and continuing to use the strategy to enhance mathematics. PAR also benefits the school as it acts as a development tool for teachers, helps point out other skills that still need development, and provides valuable resources that can be used to enhance the learning of mathematics. It transforms the knowledge learners have as they are directly involved in acquiring knowledge to change their social experience.

3.4 RESEARCH SITE

The research site for this study was a primary school in the deep rural area of Mkhondo Town in the Mpumalanga Province. It is a quintile one school with 309 learners and 10 teachers, including the principal and one HoD, then a general worker, admin personnel and three food handlers. The classes start from Grade R up to Grade 7. The home language used is isiZulu, though most learners speak a mixture of IsiZulu and SiSwati as the area is near the Eswatini border. The community suffers from most socio-economic issues, with rampant unemployment, teenage pregnancy, alcohol and orphans. The mobile clinic visits the community monthly and runs a few campaigns a year at the school, including deworming and more. The researcher selected this site and co-researchers because it is appropriate to achieve the study's objectives.

3.5 GAINING ENTRY

The request to conduct research was sent to the school's principal in a letter for authorization. Teachers were also invited in the form of a letter of concern, including acceptance letters for learners, which parents signed to allow their children to participate. The letter was sent to the Circuit Manager, and the other team communicated telephonically, and then letters were sent through emails. It was further pointed out that participation in this study is voluntary. If one felt uncomfortable, one was welcome to withdraw at any time. All other rights were also discussed in the meeting. The letter

included information about the study and further stipulated the ethical considerations such as trustworthiness, anonymity and confidentiality. It also discussed how data would be collected, including video recording, note-taking and voice recording. All co-researchers signed all letters.

3.6 ETHICAL CONSIDERATION

To ensure ethical decision-making is paramount in this research. The researcher sought ethical clearance from the University of Mpumalanga to adhere to ethical considerations. In addition, authorization for conducting research at the school was obtained from the DoE. The researcher explicitly communicated to the school and co-researchers that participation is voluntary and that gathered information will be treated with confidentiality and accessible to co-researchers upon request. Co-researchers were informed of their freedom to discontinue participation if they lost interest. A formal letter sought permission from all co-researchers. Informed consent was obtained from learners' parents or guardians for all research-related activities, ensuring the learners were briefed on issues such as anonymity, confidentiality, protection against harm and informed concern. Learners were assured their freedom to cease participation, and pseudonym names were utilised.

3.7 HUMAN AND PHYSICAL RESOURCES FOR DATA GENERATION

Most of the information in this study depends on the core researchers' views and analysed documents. Core researchers formed a coordinating team where the researcher was made a leading member of the coordinating team. The coordinating team was selected through their strength and abilities as they all know one another. They represented a wider group of core researchers who are also affected by the problem that is being investigated. The coordinating team drafted a working plan for meetings and discussions which outlined that the team would meet every week for two months, not more than one

hour. The team was also responsible for identifying key study areas that need urgent attention to achieve set goals.

3.7.1 The coordination team

This team comprised the four members of the steering team, namely the researcher, the coordinating team's leader, a Grade 1 teacher, an HoD and an administrative person. The other coordinating team members included learners, parents, Foundation Phase teachers, education officials, religious persons and IT specialists.

3.7.2 The research coordinator

The coordinator acts as a team leader of the core researchers. The researcher was guided by the principles of posthumanism theory which guided the study. She has nine years of experience, five years teaching Grade 1 and four years teaching mathematics in Grades 4-7. She is a member of the SMT and holds the qualifications of Software Specialist, NPDE, ACE and B.Ed. Honours degree.

3.7.3 Credentials of the learner

There were 35 learners in Grade 1, consisting of twenty-one boys and fourteen girls. Three boys are repeating Grade 1, and the rest are doing Grade 1 for the first time. They ranged from six to seven years of age. They all reside in the rural areas surrounding the school and mainly depend on social grants and parents who work in forestry. Two of them are orphans. They stay with their grandparents. They helped conduct the study by participating in activities in their mathematics class using tablets, including writing tasks, practising their mathematical skill using tablets, and helping their peers as they were divided into five groups. Their pseudonyms were Noxolo, Lihle, Khanyi, Nqoba and more.

Recordings and videos were made and were later transcribed, analysed, translated and interpreted. Their reflection was extracted from video recordings and written assessments. Learners used different programs to enhance their mathematical skills, and

feedback was given as soon as they finished the tasks, something that encouraged learners to master skills quickly. The positive engagement of learners exhibited both challenges and successes of the strategy to enhance the learning of mathematics in Grade 1. The learners were willing and excited to share their acquired skills.

3.7.4 Credentials of Grade 1 class teacher

This teacher is a qualified teacher and has ten years experience in teaching Foundation Phase. She is in her forties and holds an Advance Certificate in Education, majoring in mathematics and life skills in the Foundation Phase. She can be viewed as the best in understanding the mathematics curriculum for Grade 1 due to her experience and age. The pseudo name used for her was Mrs Kunene. She enjoys teaching children and tries hard to produce quality knowledge.

3.7.5 Credentials of Foundation Phase teachers

The Foundation Phase teachers are Grade R teachers with a national diploma in teaching Grade R, with about 11 years experience, and a pseudonym, Mrs Mbatha. Grade 2 teacher has an NPDE, ACE and five years teaching experience, pseudo name Miss Msimango. Grade 3 teacher has a B.Ed. Degree and about 11 years experience in teaching, pseudonym Miss Mbuli. These teachers love their work and strive to improve their school's teaching conditions.

3.7.6 Credentials of the Head of Department (HoD)

The departmental head is responsible for monitoring the proper curriculum implementation for the whole school. He has over twenty years experience in teaching and holds NPDE and ACE. He teaches IsiZulu in the Intermediate Phase. He keeps records of performances and is well informed about mathematics challenges in Grade 1. He has mathematics targets for the school, circuit and region.

3.7.7 Credentials of parents

The parents involved in the study were mainly mothers, mostly aged 17 to 36, and two grandmothers as guardians for Grade 1 learners. Most did not complete Grade 12 due to early pregnancy; only a few completed Grade 12 but did not attend tertiary education. They depend on social grants for a living, some work in forestry, and those with matric participate as assistant teachers in this school. As core researchers, they participated in finding a solution to enhance mathematics and further gained knowledge of the mathematics curriculum for Grade 1. The parents were entirely in favour of the strategy and even promised to buy tablets for their children to help them improve their mathematical skills, even at home.

3.7.8 Credentials of the principal

The principal contributed significantly to this study with 30 years teaching experience. He teaches life skills and has experience in teaching language. He is a qualified teacher with a B.Ed. Honours as his highest qualification. His experience working at this school for many years lends depth and clarity to analysing the results for Grade 1. He showed us the three-year analysis starting from 2020; the target was not reached. With this, he contributed much knowledge in finding a working strategy to enhance the learning of mathematics in Grade 1, and he said he would further encourage teachers to apply it across the phase.

3.7.9 Credentials of the curriculum developer

The curriculum developer meaningfully supported this study, having 15 years teaching experience and 11 years as a Foundation Phase Mathematics curriculum developer. She is a qualified teacher with a B.Ed. Honours as her highest qualification, as well as different management certificates acquired during her tenure. She supported this study by doing analyses on how the school performed compared to other schools in Gert Sibande, and within the circuit. She presented reports of her findings during her visits to the school. These reports showed the low level of performance in mathematics in Grade 1, where the district target was not met. She further contributed with developing strategies in using

tablets, and making sure that applications were aligned to the curriculum. Her contribution was on how to attain the targeted outcomes of learning mathematics.

3.8 STRENGTHS / WEAKNESSES/ OPPORTUNITIES/ AND THREATS (SWOT) ANALYSIS

A SWOT analysis was used to determine the study's strengths, weaknesses, opportunities and threats to the study's success. The plan strengthened the opportunities and strengths, then balanced the threats and weaknesses to achieve a successful solution, which helped the team plan and prioritise their strategy.

3.8.1 Strengths

During the first meeting, the team identified where they had expertise and strengthened their skills where they are experts. The team consisted of members who are experts in the Foundation Phase mathematics curriculum, ICT skills, collaborative skills and communication skills which enriched the study. The principal allowed school tablets in this study, and some parents brought their tablets for all learners. Admin personnel helped the Grade 1 teacher to advance her skills in using a tablet. Then, the curriculum developer encouraged the parents to be fully involved in their children's learning and encouraged community mathematics to which learners relate.

3.8.2 Weaknesses

They identified their weakness in enhancing the learning of mathematics in Grade 1 and realised that team teaching and appropriate knowledge of the mathematics curriculum could be their strength. As a result, team members used their expertise as their strength. Another weakness was the parents' literacy skills; some did not attend school. However, the team's togetherness helped solve the problems by helping one another where they fell short.

3.8.3 Opportunities

Team members used their different experiences and knowledge to teach Grade 1 mathematics. Their knowledge levels in other sectors allowed them to assist one another in finding the accurate strategy. The experience of teachers helps to use different teaching methods to attain the targeted goal, and the curriculum developer's knowledge of the Grade 1 mathematics curriculum helped develop skills expected for learners to adhere to. The admin skills helped with developing tasks and with the ICT skills.

3.8.4 Threats

One of the significant threats was the authority dynamics, the traditional belief that teachers and government officials are superior to parents. It became difficult for parents to state their views. General discomfort was visible when there was the fear of rejecting opinions from the teachers, and the parents were sometimes scared to ask questions.

3.9 STUDY CONCEPTUALIZING

The study attempted to answer the following question:

How can we enhance the learning of Grade 1 mathematics at a school in Mkhondo?

In response to this question, the study aimed to design a strategy to enhance the learning of Grade 1 mathematics using tablets at a school in Mkhondo. The following objectives were formulated:

1. To investigate the challenges of enhancing the learning of mathematics using a tablet in Grade 1.
2. To explore solutions to the challenges of enhancing the learning of mathematics in Grade 1.
3. To analyse conducive factors for enhancing the use of tablets in learning mathematics Grade 1.
4. To identify possible threats when using tablets in Grade 1 teaching of mathematics.

5. To investigate whether the solutions to the challenges acknowledged are operative.

3.10 STRATEGIC PLAN

The team was to formulate the strategic plan and the implementation plan. For the effectiveness of the plans, they set clear priorities to ensure that the best needs are met by the research and evaluate all challenges faced well. Team members negotiated problems that must be tackled first and devised the strategic plan. In this study, the team decided to start with a research team formulation that will serve as the coordinating team and generate space for presentation and unravelling problems. The coordinating team organised the lesson planning sessions and the lesson presentation. It later evaluated it by debating apprehensions from the classroom activities of co-researchers, particularly those relating to pedagogical difficulties and meetings related to supporting learners as parents and the importance of using a tablet. As teachers, they decided to have workshops on safeguarding the learners' health physiological and psychological well-being when implementing the strategy.

Table 3.1: Study priorities

PRIORITIES	ACTIVITY	RESPONSIBLE PERSON	RESOURCES	TIME FRAMES	MONITORING
PRIORITY 1 Empower teachers to create lesson plans that integrate learning outcomes using tablets	• Establish lessons on tablets • Workshop by senior teacher on learning outcomes • Workshop by admin on ICT skills	SMT & admin clerk	Classroom Tablet CAPS documents Online classrooms	one-hour meeting for a period of one month, two sessions	Engage in discussion and creation on tablet

	•Online lessons on alignment of CAPS, learning outcomes and tablet				
PRIORITY 2 Empowering teachers in building knowledge and facilitation using tablets	•Workshop by HoD on how to build knowledge using a tablet •Workshop by teacher applying different processes •E-classroom workshop on building knowledge •Online development by subject advisor	Team members, subject advisor	CAPS Policy Tablet Classroom	two hours a week for a month	Discuss different ways to improve learner's knowledge. Practise activities with learners
PRIORITY 3 Empowering teachers to create assessments using tablets	•Workshop on designing assessment using tablets •Selecting activities that are aligned with the lesson outcome •Development of cognitive	Study coordinator, HoD	CAPS Policy Tablet e-classroom	three hours in three weeks	Discuss the establishment of assessment on tablets

	levels using tablets				
PRIORITY 4 Empowering collaborative learning and participation using tablets	•Workshop on peer and group teaching using tablets •Utilisation of WhatsApp to achieve collaborative learning •YouTube video teaching about involving all learners to participate collectively	Team members	Tablet	two hours per week for a month	Allowing groups and peer teachings
PRIORITY 5 Empowering teaching involving real-life situations	•Workshop by subject advisor on how to apply real-life situations in maths using tablets •Workshop by MSTA •YouTube videos doing fractions that involve real-life situations	Parents, teachers	Tablet Classroom Internet	2 hours per week for a month	Discuss the use of tablets to solve problems

The co-researcher and available researchers analysed the lesson presented together with the learners. A platform was created for learners to share their experiences of the lessons as a way of evaluating the lesson.

Gaps were identified, and suggestions for improvement were made. The co-researchers discussed the narrative account of what happened during the lesson. The aim was to make sense of the team's interpretation and understanding of their situation and how it could be improved.

3.10.1 Identifying the team

The research team was identified. The team was divided into a steering team, which included a Grade One teacher, the researcher, HoD and the administrative person responsible for the running of the team's function to achieve the study's aims. Then, the bigger team comprised all co-researchers, namely three teachers from Grades R, 2 and 3, the curriculum implementer, principal, parents and 35 Grade1 learners. The team members chose the teams' roles, and stipulated that roles would be changed frequently.

3.10.2 Identifying a problem to investigate

The researcher conceptualised the problem and presented it to the team to adopt, rephrase or reorganise. After having the research team, the researcher presented the issue to the co-researchers. The problem was how to enhance the learning of mathematics in Grade 1 using tablets. The researcher identified other problems which the participants had.

3.10.2 Identifying the resources to be used

The researcher identified resources to be used during the study, including tablets, laptops, video cameras, voice recorders, USBs and connections to the Internet. Most parents that were involved in this study were able to walk to school. Some parents owned tablets, which increased the number of tablets used during the study.

3.10.3 Formulating the project plan

The team requested a timetable for the Grade 1 class. They paid a visit to the class for observation during the mathematics period. The team analysed and examined the learners' classwork, homework books and workbooks. Meetings were organised to explore a strategy that can be used to improve teaching and the learning of mathematics in Grade 1 after visits. Video and voice recordings were taken during meetings, encouraging the team to work hard to find solutions.

3.10.4 Joint analysis of data

After the data was generated, analysed, and interpreted using CDA, which everyone in the team accepted, several technology gadgets were used to create descriptive accounts of the data collected. Through their communication skills, the team communicated very well with each other during the analysis process.

3.10.5 Formalization of results

To ensure ethical decision-making is paramount in this research. The researcher sought ethical clearance from the University of Mpumalanga to adhere to ethical considerations. In addition, authorization to conduct research at a school was obtained from the Department of Basic Education. The researcher explicitly communicated to the school and co-researchers that participation is voluntary and that gathered information will be treated with confidentiality and accessible to co-researchers upon request. Co-researchers were informed of their freedom to discontinue participation if they lost interest. A formal letter sought permission from all co-researchers. Informed consent was obtained from learners' parents or guardians for all research-related activities, ensuring the learners were briefed on issues like anonymity, confidentiality, protection against harm, and informed consent. Learners were assured their freedom to cease participation, and the use of pseudonyms were honoured.

3.10.6 Taking action

The most crucial step to be taken was to implement a discovered solution, as the main aim was to enhance the learning of mathematics and attain more significant results. These results may create awareness to the DoE on using tablets to improve the learning of mathematics using tablets. This may lead to using tablets across the phase, the change of policies and provision of such resources.

3.10.7 Monitoring implementation and captured data

After discussing a solution, the team returned to the school to report the findings to everyone. This was done to raise awareness about the lack of gadgets for teacher development that could be organised within or outside the school. The learning of mathematics using tablets was enhanced and visible in their daily work.

3.11 TOOLS FOR GENERATING DATA

The research team has to have specific tools at its disposal to collect data. Video and voice recordings were used in this study. Documents such as lesson plans, worksheets, and tasks also provided a rich base for collecting data.

3.11.1 Video and voice recorder

In this study, video and voice recorders were used to collect data. These were used to record spoken words from core researchers and actions, including that of learners during lessons. The video and voice recordings were handy as they recorded all necessary meeting activities so the coordinating team could reference them when lost. The video recorder allowed core researchers to notice the difference in learners' performance and participation compared to past videos.

3.11.2 Document analysis

To find an effective strategy, the team had to analyse different documents, including lesson plans, assessment records and general administrative work done to enhance the learning of mathematics in Grade 1 which was done to understand the different approaches and skills used or developed to improve the learning of mathematics..

3.11.3 Participant observer

To be a participant observer was another way of collecting data as the researcher found a strategy among the core researchers which allowed her to collect data, allowing the researcher to get to know and understand all the core researchers and understand the challenges in their point of view. During such observation, the researcher recorded all crucial moments and facts in diaries which were then translated into themes after observation.

3.11.4 Free Attitude Interview (FAI) technique

The team applied principles that allowed co-researchers to speak out on issues, and to freely share their experiences. to do so allowed everyone on the team to fully understand the conditions and struggles that are faced by teachers in their work place. Free attitude interviews allow co-researchers to voice their views in any way, while remembering to stay within the framework and remain focused on the topic (McGrath, Palmgren, Liljedahl, 2019: 1004). Therefore, in this study, every co-researcher was able to talk about their concerns and to make suggestions in finding relevant strategies pertinent to the study.

3.11.5 Data generation

The research team addressed the challenge of improving Grade 1's learning of mathematics using tablets. Team members unanimously acknowledged that enhancing mathematics through tablet integration could improve Grade 1 mathematics results. Co-

researchers strategised to tackle this issue, and the research process was scheduled to commence in September 2023, unfolding in phases until November 2023. The team scrutinised various aspects of the school's programs, including timetables, mathematics objectives, lesson planning and more.

In their inaugural meeting, co-researchers deliberated on their approach to finding a solution for the identified problem. The session commenced with an overview of the study's goals, objectives, and the relevance of employing PAR. The researcher elucidated the methods for data collection and analysis. A workshop provided co-researchers insights into PAR, data analysis techniques and all study aspects. The session concluded with discussions and questions, allowing co-researchers to seek clarification and propose optimal approaches for the study. The meeting was documented through audio recordings and written minutes.

3.12 DATA ANALYSIS THROUGH CRITICAL DISCOURSE ANALYSIS (CDA)

Critical Discourse Analysis (CDA) was applied in this study to analyse and interpret the data. CDA supports empowering the oppressed communities to classify any effort by the authorities to spread, ratify, and legitimise injustice to keep up their cycle of oppression and authority over them (Fairclough, 2013:1). The term "Critical Discourse Analysis" refers to an effort or analysing procedure to explain a text (social reality) and is approved by a person or group working towards a programmed goal. Some features of critical discourse analysis include history, context, action, power and philosophy. It is notable that CDA deals with broad power relations (Shah & Yasir, 2021:666). Furthermore, feminist critical discourse analysis is mostly associated with how language and gender relate: it looks at how men and women exercise power in public. According to research, social and cultural influences are most likely to hinder the cognitive performance of males and females (Johnson & Flynn, 2021:442). Three levels of data analysis were used in this study.

3.12.1 Textual level

At the textual level of analysis, which refers to any textual piece of work which contains communicative aspects of language, the analysis of text helps to uncover ideological assumptions that are embedded in the text (Al Falaq & Puspita, 2021:66). The team focused mainly on the lesson plans presented, the mathematics workbooks of the learners in Grade 1 when analysing the texts, which also included the written and oral material gathered in the classroom to investigate the teaching and learning process, the interactions between the teacher and the learners, and the interactions amongst the learners themselves. According to Al Falaq and Puspita (2021:62), knowledge is stored in our thoughts. Hence, text analysis affects our knowledge.

When the team analysed data, they had it in their minds that limiting their analysis to a mere synthetic analysis would make them lose meaning, as some linguistic features cannot be grasped precisely. It was noted that certain team members were advanced and illiterate and would not understand some of the technical language used, unlike the younger generation of parents.

3.12.2 Discursive level

In CDA, the discursive practice level refers to producing, receiving and interpreting a message using social norms, rules, and mental models of appropriate behaviour in particular circumstances, roles or relationships. It consists of both spoken and unspoken laws. Its primary purpose is to make co-researchers realise that things are as they should be. The discursive level, when using the Fairclough model of analysis, is also concerned with how the public consumes the text at the production, distribution and consumption levels (Al Falaq & Puspita, 2021:62).

For this study, the discursive practice level was according to community norms and values of learners, parents' respect towards the teacher and learners freely engaging with the teacher. The introduction of a cell phone to teaching and learning brought about a feeling of acceptance after parents had been taken through how it would be done and how they should be involved as a support structure to both the teacher and the learners.

3.12.3 Social level of analysis

According to Mogashoa (2014:104), CDA is motivated and particularly interested in understanding urgent social concerns that affect marginalised populations, as suggested by Van Dijk (2006:252). Analysis at the social level is concerned with the notion of the text being more than just words but discloses rights and obligations by avoiding contradictions in the text. It cannot be rejected or deemed risky; it is free of discrimination and toxic masculinity (Al Falaq & Puspita, 2021:63; Mogashoa, 2014:106). Mogashoa (2014:106) further indicates that CDA aims to connect the dots between the actual text, discursive practices, the broader social environment, power enactment and discourse production, and the socio-cognitive interface between production and domination to understand their relationships.

This study employed CDA to examine and reveal the power dynamics contributing to social inequality. The aim was to gain a deeper understanding of the discourse within the mathematics classroom at the school and to identify instances of power dominance that hinder individuals from recognizing dominant ideologies. The study sought to unveil oppressive discourses that disempower individuals, preventing them from exploring alternative solutions to their social problems.

3.12.4 Limitations of Critical Discourse Analysis

Critical discourse analysis (CDA) comes with different limitations. CDA is known for the analysis of data from different approaches; analysis which may result in finding the most suitable solution for a specific challenge (Jacobs, 2021: 156). CDA tends to be interpretive and subjective in its analysis, meaning that most analyses are subject to the agendas and prejudices of the analysers (Sherwani, 2021: 18). Most analysts of CDA do not separate their own beliefs and values from the research (Jacobs, 2021: 156). Thus, analysis using CDA tends to take up a lot of time due to this limitation. In this study, such limitations were addressed by ensuring that data was analysed in a fair way - by not allowing different agendas to harm the process, but focussing on finding the strategy that will be suitable for the school in Mkhondo.

3.13 SUMMARY OF THE CHAPTER

The study's research design was the current chapter's main topic, with PAR as the best direct approach. The co-researchers roles and duties were the emphasis of the research design to accommodate data generation and facilitate planning, implementation and reflection. It highlighted the part played by the researcher and the interaction with other researchers, something that demonstrated that everyone was on an equal footing with everyone else and that no one was superior to them. Data were generated using audio and video recordings, pictures, observation and free attitude interviews.

Data was analysed using CDA, focusing on textual, discursive and social analyses. Data analysis was aligned with the theoretical framework of the study. Data analysis, data presentation, and interpretation of results are dealt with in the following chapter.

CHAPTER 4: ANALYSIS OF DATA, PRESENTATION, AND INTERPRETATION OF RESULTS

4.1 INTRODUCTION

This study aims to develop a strategy for improving Grade 1's learning of mathematics using tablets at a school in Mkhondo. This chapter deals with the analysis, interpretation and presentation of results derived from the data, outlining the strategy to enhance the learning of mathematics in Grade 1. The data is categorised based on the five objectives outlined in previous chapters. These objectives include investigating challenges, exploring solutions, analyzing conducive factors, identifying potential threats, and assessing the effectiveness of the implemented solutions in enhancing Grade 1's learning of mathematics with tablets. The data analysis employs CDA within the theoretical framework of posthumanism and the conceptual framework of connectivism.

4.2 IDENTIFICATION OF CHALLENGES TO ENHANCE THE LEARNING OF MATHEMATICS IN GRADE 1

Previous research discovered various challenges which were ranked most essential and needed further research. The following challenges were identified: (i) lesson plans that do not integrate tablets in designing learning outcomes, (ii) knowledge-building and facilitation of Grade 1 mathematics without using tablets, (iii) assessment that does use tablets, (iv) collaborative learning and participation of learners without using tablets, (v) teaching mathematics involving real-life situations without using tablets. These will now be dealt with.

4.2.1 Lesson plans that do not use tablets in designing learning outcomes

The effectiveness of tablets in enhancing mathematical skills relies on the users' ability to operate them for improved learning of mathematics. However, a significant challenge has been the development of lesson plans that seamlessly integrate tablets to achieve desired

learning outcomes, resulting in suboptimal mathematics performance. The Curriculum and Assessment Policy Statement (CAPS) (DBE, 2018:37) underscores the importance of lesson planning by teachers to target knowledge and understanding skills, encompassing counting across various number ranges and encouraging the application of mathematical strategies to problem-solving.

CAPS advocates for the effective implementation of mathematics content, urging teachers to stimulate all senses by integrating technology such as tablet videos, pictures, and other necessary manipulatives (DBE, 2020:3). In addition, CAPS promotes lessons with specific outcomes that guide learners from the unknown to the known, encouraging activities such as data collection, knowledge application, problem-solving, and the presentation of mathematical concepts. Tablets can transition from concrete experiences, such as photos, videos, or music to abstract representations, including symbols.

However, previous research has highlighted the ongoing challenge of integrating tablets into lessons with specific learning outcomes across different countries. Teachers often struggle to effectively use tablets in lessons requiring concretization, especially during rhythmic counting using music and videos. Difficulties also arise when integrating tablets into the investigation and knowledge phase, where learners' senses of perception are stimulated, such as incorporating movements into counting or solving problems related to money (Forster, Maur, Weiser & Winkel, 2022:12).

Similarly, the integration of tablets when guiding learners to discover their learning styles using various manipulatives and presenting graphic data necessitates well-planned lessons (Papadakis et al., 2021:6). Learning theories in mathematics education, such as scaffolding, emphasise the use of gadgets or resources to enhance mathematical skills (Dore & Zimmermann, 2020:4). Bloom's taxonomy underscores that learners should apply knowledge, compare and relate numbers, calculate, solve and analyse numerical concepts.

Active engagement of learners is crucial in using the environment or physical manipulatives such as tablets to make sense of number concepts. Moreover, effective learning occurs when learners engage with experienced and qualified individuals, such as teachers, with the support of tablets to enhance mathematical skills.

Lesson Plans			Term 2		Gr. 1		
Date: 8-12 May 2023							
Week	Content Area	Topic	Monday	Tuesday	Wednesday	Thursday	Friday
Counting	Oral Daily	Count Objects	Count and compare objects up to 10	Count and compare objects up to 10	Count and compare objects up to 10	Count and compare objects up to 10	Count and compare objects up to 10
		Count forwards and backwards to 10	Count forwards and backwards to 10	Count forwards and backwards to 10	Count forwards and backwards to 10	Count forwards and backwards to 10	
		Count backwards from 10	Count backwards from 10	Count backwards from 10	Count backwards from 10	Count backwards from 10	
		Counting with Number Patterns and Missing Numbers	Counting with Number Patterns and Missing Numbers	Counting with Number Patterns and Missing Numbers	Counting with Number Patterns and Missing Numbers	Counting with Number Patterns and Missing Numbers	
		Number Names and Symbols	Number Names and Symbols	Number Names and Symbols	Number Names and Symbols	Number Names and Symbols	
	Oral Daily	Describe, compare and order objects to 10	Describe, compare and order objects to 10	Describe, compare and order objects to 10	Describe, compare and order objects to 10	Describe, compare and order objects to 10	
		Describe, compare and order numbers to 10	Describe, compare and order numbers to 10	Describe, compare and order numbers to 10	Describe, compare and order numbers to 10	Describe, compare and order numbers to 10	
		Problem Solving	Problem Solving	Problem Solving	Problem Solving	Problem Solving	
		Mental Maths	Mental Maths	Mental Maths	Mental Maths	Mental Maths	
		Short group teaching	Short group teaching	Short group teaching	Short group teaching	Short group teaching	
Numbers, Operations and Relationships	Oral Daily	Describe, compare and order objects to 10	Describe, compare and order objects to 10	Describe, compare and order objects to 10	Describe, compare and order objects to 10	Describe, compare and order objects to 10	
		Describe, compare and order numbers to 10	Describe, compare and order numbers to 10	Describe, compare and order numbers to 10	Describe, compare and order numbers to 10	Describe, compare and order numbers to 10	
Measurement	Oral Daily	Length	Length	Length	Length	Length	
		Area	Area	Area	Area	Area	
Data handling	Oral Daily	Collect and organise data	Collect and organise data	Collect and organise data	Collect and organise data	Collect and organise data	
		Interpret data	Interpret data	Interpret data	Interpret data	Interpret data	
DBE	Oral Daily	Support	Support	Support	Support	Support	
		Reflection	Reflection	Reflection	Reflection	Reflection	
Educator: [Signature]	HOD: [Signature]	[Signature]	[Signature]	[Signature]	[Signature]	[Signature]	

Figure 0.1: Lesson plan that does not integrate a tablet.



Figure 0.2: Learners using empty packets for data handling.

Figure 4.1 shows the lesson teaching plan that does not integrate the usage of tablets in designing learning outcomes, as on the first activity which is counting. Here, the teacher could have used music or video with numbers to assist learners with counting to reach the outcome of counting in 2s and 5s. She further gives learners an activity on describing and comparing numbers without integrating tablets. When comparing and describing numbers, learning outcomes can be achieved using a tablet by stimulating many senses in learners with bright colours and moving and touching numbers. Figure 4.2 shows learners in a data- handling activity where they collect and sort data. Learning outcomes

of interpreting and analysing data can be attained using tablets as they have a variety of data that can be sorted without putting a learner's health at risk with unhygienic contaminated dirty empties, as it uses different data that allows learners to sort it according to shape, colour and size.

Posthumanism associates itself with the entanglement of learners' knowledge, and learning outcomes are linked through the lesson plan that integrates tablets where learners explore and increase knowledge, achieving different learning outcomes (Murriss & Kohan, 2021:586). A tablet comes as a cyborg that maximises learners' projected skills by providing learners with various quiz puzzles that teach mathematics and improve learners' performance (Hase, 2020:2). Posthumanism is strongly embedded in the specificity of relations that develop and establish the relating of the teacher and learners through the use of tablets. It decentres the human individuality and emphasis in connections and interactions with the non-human (Fairchild, 2019:56). CDA makes sense of the analysed data through text from participants and discloses its meaning in discursive exercise and social construction (Mceleli, 2019:69). Learners were disempowered by limiting them to the use of tablets that came with different ways that could enhance the learners' mathematical skills through its practical usage. Connectivism pays attention to the learner's capacity to animate, work and thrive within a wider interconnected community. It emphasises the expansion of identities using tablets in classes and improving mathematical skills. Therefore, in this challenge, a tablet was not utilised to acquire most projected skills (Downes, 2022:2).

The findings are that the teaching mode did not encourage tablet use, and its potential to enhance mathematics was limited.

4.2.2 Knowledge-building and facilitation of Grade 1 mathematics without using a tablet

The DBE (2018:8) outlines the importance of fostering the learners' mathematical knowledge, particularly in physical, social and conceptual understanding. In the physical domain, learners are encouraged to discover and explore concepts such as collecting,

telling time, and analysing number patterns using various tools and shapes, fostering a deeper understanding of the world (Shumway, 2023:2).

As emphasised by the DBE (2011:32), the development of social knowledge hinges on effective communication and relationship formation. For instance, when learners are tasked with sorting or comparing shapes based on dimensions, such as straight or round shapes, their comprehension is enhanced when they know the properties of these shapes.

Similarly, conceptual knowledge, called logical knowledge, necessitates the learners' ability to synthesise information from observations and construct answers based on prior knowledge. However, previous research indicates a deficiency in teachers' skills to develop knowledge using tablets, particularly in guiding learners to explore and discover facts independently, such as understanding different shapes and their properties through physical, social, and logical perspectives.

The construction of knowledge in mathematics occurs through three dimensions: physical knowledge, social knowledge and conceptual knowledge, with tablets serving as valuable resources to facilitate this development.

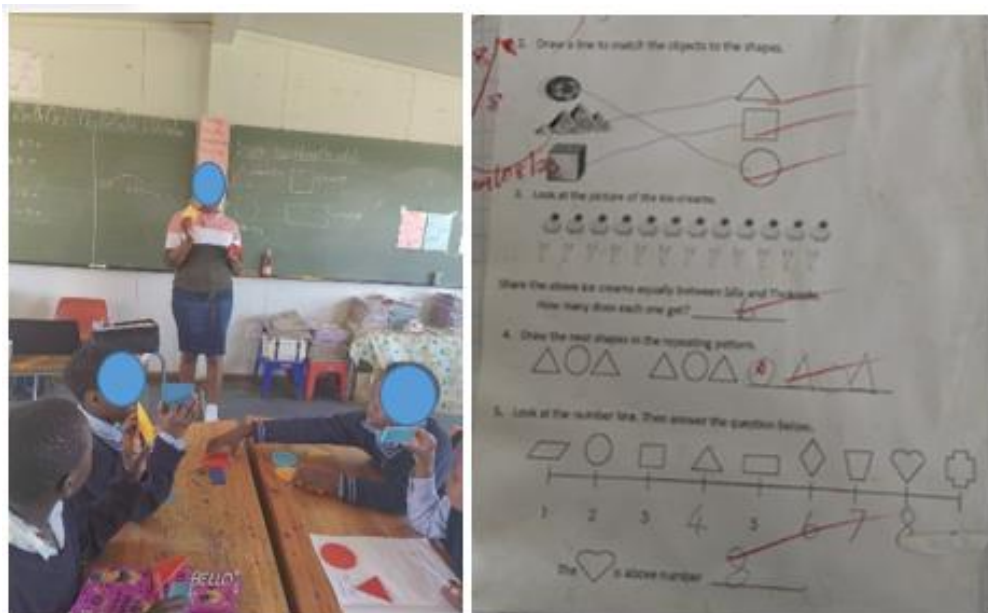


Figure 0.3: Teaching a lesson on shapes and properties, and a learner's activity page.

Figure 4.3 shows a teacher holding up shapes to learners that limit the learners' imagination. In contrast, a more colourful variety of shapes can be viewed as offered and available when using tablets. A tablet also enables learners to draw, paint and position shapes according to instructions during utilization. The learners' activities on geometric patterns that are so dull without anything stimulate learners' participation. In contrast, a tablet provides different patterns where learners can interact lively with shapes as it allows them to execute their properties while interacting with them in a tablet.

Posthumanism concerns itself with dualistic thinking. In this case, teachers did not allow any duality of minds in using the tablets to increase intelligence with applications following interactive worksheet about number patterns in building mathematics knowledge (Motala & Stewart, 2021:12). An analysis of this challenge posed by CDA reflected on activities which teachers believed was the correct way to build knowledge. Still, learners were not given opportunities to access the programs on a tablet, such as puzzles, quizzes and games that build mathematical knowledge (Mbiza, 2022:15). Connectivism states that learning and knowledge rest on a variety of opinions; tablets connect learners' skills to the present and future concepts in mathematics being able to core-link the previous, current and future skills (Kolobe, 2022:3).

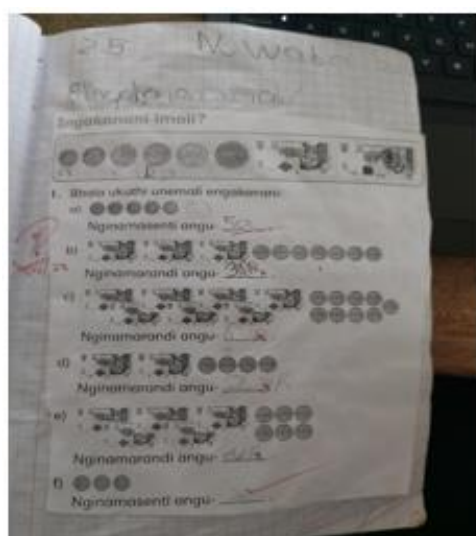
Findings were that teachers denied learners an opportunity to enhance and build on knowledge in mathematics using tablets and only allowed them to use old ways of learning.

4.2.3 An assessment that does not use tablets

The DBE (2018:485) distinguishes between informal and formal assessment approaches guiding tools, including tablets. It underscores the need for evaluation to encompass a range of cognitive levels, emphasizing the significance of assessment in gauging learners' knowledge.

Earlier research highlighted challenges faced by teachers in utilizing tablets for holistic learner assessments. Individual learners possess unique skills, requiring varied assessment methods tailored to different cognitive levels. Effective teaching of

mathematical concepts with specific goals is essential before conducting assessments to ensure validity and reliability.



Activity 2 - Oral		
Number, operations and relationships: Counting		
Count forwards and backward between 0 and 80		
Level		Observation Criterion
1	0 - 29%	Unable to count in 1's from any given number between 1 and 80
2 - 3	30 - 39%	Unable to count in 10's from any multiples of 10's between 0 and 80
4	40 - 49%	Able to count in 5's from any multiples of 5 between 0 and 80
5	50 - 59%	Able to count in 2's from any multiples of 2 between 0 and 80
6	60 - 69%	Can use a number grid to identify a number pattern by circling/colouring in the numbers in the pattern
7	70 - 79%	Can use a number line to identify a number pattern and sequence the numbers on the number line
8-10	80 - 100%	Can create own number patterns with numbers between 0 and 80

(10)

Figure 0.4: Assessment with no feedback and assessment done orally, without checking the level of understanding.

Figure 4.4 illustrates an assessment approach for learners without feedback, only evaluating the same cognitive level. In contrast, tablets allow learners to identify and rectify errors, offering the chance to again teach concepts that pose difficulties. Tablets also elevate the questioning level, assess learners until they achieve mastery at a higher-order level.

Posthumanism challenges the reliance on traditional assessment methods, advocating the use of gadgets that cater to different learning styles and encourage learners' diverse perceptions (Murriss, 2020:11). CDA was employed to analyse learner activities and discussions among the team and teachers, revealing discursive power relations that restrict learners from using tablets for assessment, limiting their exposure to various skill levels (Hlatshwayo, 2023:6). Connectivism promotes active learner engagement in problem-solving and using networks for solutions. In this context, learners were not empowered to utilise networks in completing assessments.

4.2.4 Collaborative learning and participation of learners without using tablets

The CAPS Policy advocates collaborative learning, highlighting the importance of peer learning, small-group teaching and whole-class activities in developing mathematical concepts. It acknowledges that some learners thrive in a peer-learning environment. The E-Learning Policy (DBE, 2020:3) underscores the necessity of online collaborative learning, promoting the integration of technology and the mathematics curriculum. However, research indicated that teachers faced challenges in implementing collaborative learning using tablets, and group learning lacked effective control. Online learning did not significantly enhance mathematics knowledge through enrichment activities, and poor communication via social media hindered the improvement of mathematics concepts. According to Vygotsky (1978), cognitive learning is facilitated through social interactions, suggesting learning is more effective when learners engage with peers, adults or technological learning tools.

Mrs Mbhatha: “I’m unable to use tablets on collaborative learning when teaching basic operations, especially addition.”

Mrs Mbuli: “I also find it difficult to communicate with learners using WhatsApp, to give them homework or to remind them with an example in number patterns.”

Mrs Kunene: “Group teachings using tablets is difficult as some learners tend to play, some don’t participate. And in most cases, a group member disturbs others by playing games not **related** to given work.”

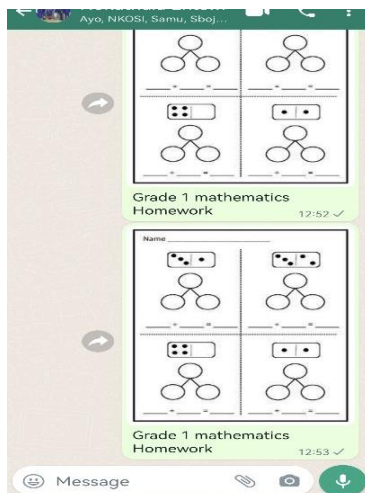


Figure 0.5: WhatsApp homework with no information detailed.

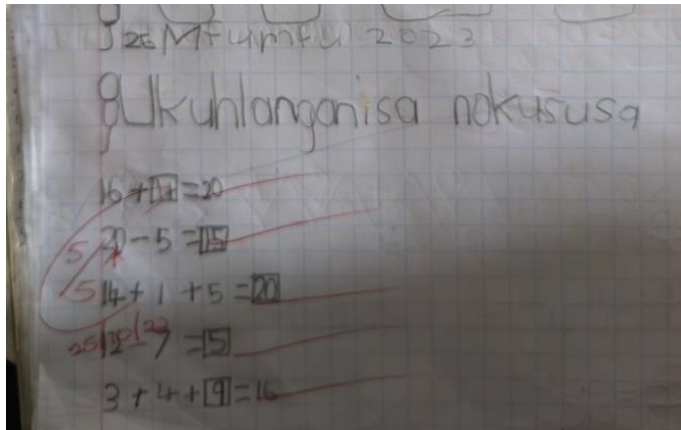


Figure 0.6: Number bonds addition without using tablets.

Figure 4.5 depicts a WhatsApp group message in which a teacher assigned homework to learners without providing instructions or detailed explanations. Instead of utilizing tablets to record video explanations with examples for both learners and parents, the teacher relied on written instructions. Figure 4.6 illustrates a group activity on number bonds, where learners were expected to collaborate. The use of tablets could have facilitated communication, whether learners were at school or home, as tablets support peer teachings.

Data analysis was conducted using CDA. Van Dijk (1998) describes CDA as research on how social authority, dominance, and inequality are expressed, reproduced, and contested through text and talk in the socio-political domain. CDA emphasises the interconnectedness of text and society. Therefore, tablets should be employed to connect learners' knowledge with the diverse aspects of the world, enabling them to link mathematical concepts with their societal context. Posthumanism advocates the interaction between learners and tablets to enhance and expose learners to various ways, allowing them to acquire new skills or master existing ones. Connectivism promotes learning to occur everywhere, involving different people or devices, with tablets facilitating easy access to information (Boyras & Ocak, 2021:1128).

The findings indicated that teachers did not utilise tablets to teach mathematics, limiting the growth of collaborative learning among learners.

4.2.5 Teaching mathematics involving real-life situations without using tablets

The DBE (2018:9) underscores the significance of creating awareness regarding mathematics' crucial role in real-life situations. This involves the learner's personal development, connections with social structures and technology integration to enhance mathematical understanding in practical contexts. However, prior research indicates that teachers still face challenges in integrating tablets effectively in teaching mathematics, particularly in measurement, comparing length, number patterns and input-output concepts. The involvement of real-life situations is crucial in addressing challenges related to fractions, 2D shapes, and the understanding of mass. To learn mathematics is intricately linked to what learners engage with and the life experiences that allow them to effectively connect mathematical concepts with problem-solving. Learners thrive in environments, situations and with people they can relate to, enhancing their ability to comprehend and apply mathematical principles.

Mrs Msimangu: “When I teach about mass, I find it so difficult to link it with tablets.”

Mrs Kunene: “I’ve noticed also because we are used **to** using things that learners could touch and are well aware of, for example, comparing mass from a brick and apple. **They** relate well as they know bricks are heavier than apples in real life. Then using tablets comes tricky.”

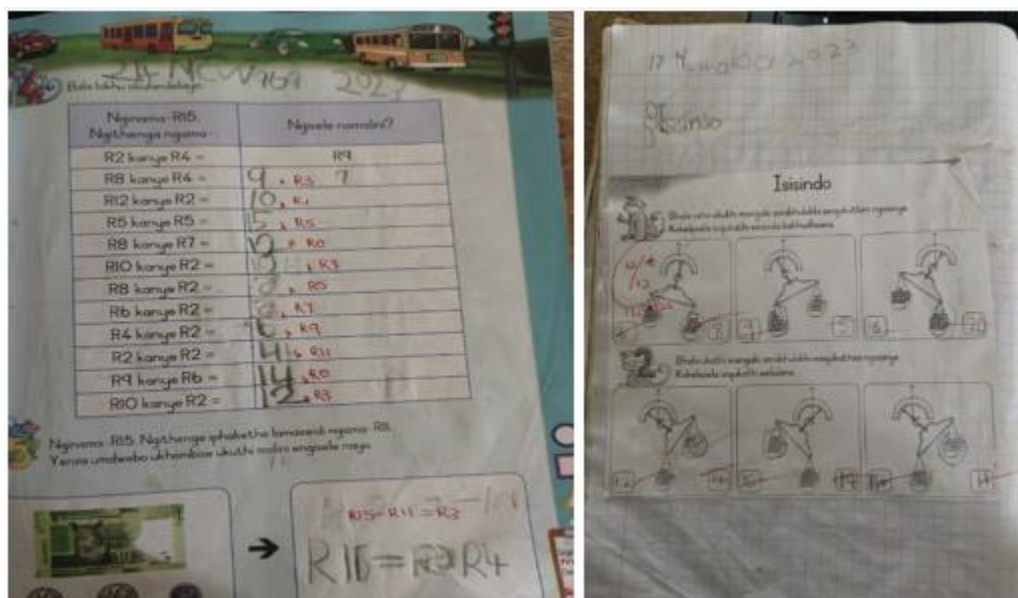


Figure 0.7: Learners' activity attempts in money addition sum without tablets.

In Figure 4.7, learners' work illustrates instances where tablets were not utilised when teaching about money. Real-life situations can be better processed through tablets, allowing learners to engage in activities such as virtual shopping to develop problem-solving skills involving money. The second image depicts an activity related to mass, where learners are asked to determine which objects are heavy and light. Tablets facilitate interactive learning experiences, enabling learners to practically explore concepts by attempting to balance different objects to estimate and measure mass.

The analysis conducted through CDA gives a voice to marginalised learners currently deprived of the opportunities to leverage the power of tablets in learning mathematical concepts (Fairclough, 2023:11). Posthumanism emphasises the interconnectedness of humans, the environment and social culture. Therefore, learning mathematics in real-life situations using tablets allows learners to acquire mathematical skills relevant to their daily life experiences (Maawali, 2022:307). Connectivism enables learners to integrate pre-existing knowledge with newly acquired skills, fostering a personalised understanding of the learning process (Mthethwa, 2022:2).

The findings suggest that teachers were not utilizing tablets to assist learners in solving problems that relate to their real-life situations.

4.3 SOLUTIONS TOWARDS CHALLENGES TO ENHANCE LEARNING OF GRADE 1 MATHEMATICS USING TABLETS

This section provides possible solutions from the previous research, such as theoretical guidance, realistic evidence, and empirical data for enhancing the learning of Grade 1 mathematics using tablets at a school in Mkhondo, as discussed earlier. The following is evidence of solutions to the challenges that are identified: (i) solutions to lesson plans that do not integrate tablets in designing learning outcomes, (ii) solutions to knowledge-building and facilitation of Grade 1 mathematics without using tablets, (iii) solutions to the assessment that does use tablet, (iv) solutions to collaborative learning and participation of learners without using tablets, (v) solutions to teaching mathematics involving real-life situations without using tablets.

4.3.1 Development of lesson plans that integrate tablets in designing learning outcomes

Teaching continues smoothly when the lesson is well planned, its projected outcomes and resources used (Mceleli, 2019:276). Similarly, teaching using ICT gadgets such as a tablet could improve learners' performance, bring along multiple learning experiences and stimulate a learner's intelligence (DBE, 2020:5). Furthermore, a good lesson plan guides learners on how to gain new knowledge by employing different models and ways that can help to construct knowledge.



Figure 0.8: Teacher development on lesson plans using tablets

This study created opportunities for teachers to empower themselves to create a lesson plan that integrates tablets by creating a professional learning community in the school, where teachers can be trained in planning lessons and everything about teaching. The team started by involving the school administrative clerk to facilitate and refine the team's MS Office skills, which occurred twice a week for teachers to be able to administer lesson plans on a tablet. It was agreed that each member in a group will get a slot to teach the team everything new that will help them refine their skills. Consequently, the HoD also shared how to create a lesson plan integrated with a tablet and requested teachers to use

the information given to check for improvement. The subject adviser suggested online websites that train teachers for free using tablets.

The team agreed to create these professional developments as part of the school culture for prolonged teaching and learning.

4.3.2 Solutions to knowledge-building and facilitation

The most important part of teaching is to build fundamental knowledge to create critical thinkers who can think carefully and form opinions on mathematical problems based on their internally constructed ideas about mathematical concepts. Knowledge is produced differently; each learner should be able to tap into all levels of knowledge-building to master concepts. Learners who have built mathematical knowledge well can solve mathematical problems involving any concepts and become creative and critical thinkers (Tsakeni, 2021:1).



Figure 0.9: Development of knowledge-building

The team requested the subject advisor to teach them how to build knowledge using tablets. She facilitated and developed members by showing them how to create activities that build knowledge in mathematics. The team invited a teacher from a neighbouring school who had been using tablets for years to share and teach members how to build

mathematical knowledge using tablets. The team agreed to keep inviting these teachers every month to develop them in this topic and that team members are to support one another in developing the integration of tablets in knowledge-building.

4.3.3 Solutions for creating assessments using tablets

Evaluation is pivotal in the teaching process as it allows teachers to assess the attainment of anticipated skills and gauge whether the objectives have been met. It serves as a tool for teachers to formulate plans for reinforcing concepts that may still need development. In addition, assessment allows teachers to introduce new concepts once learners have mastered the initial ones. Moreover, assessment enhances instruction by emphasizing the significance of critical thinking, reasoning and reflection, thereby creating a high-quality learning environment enriched with various resources, including tablets.

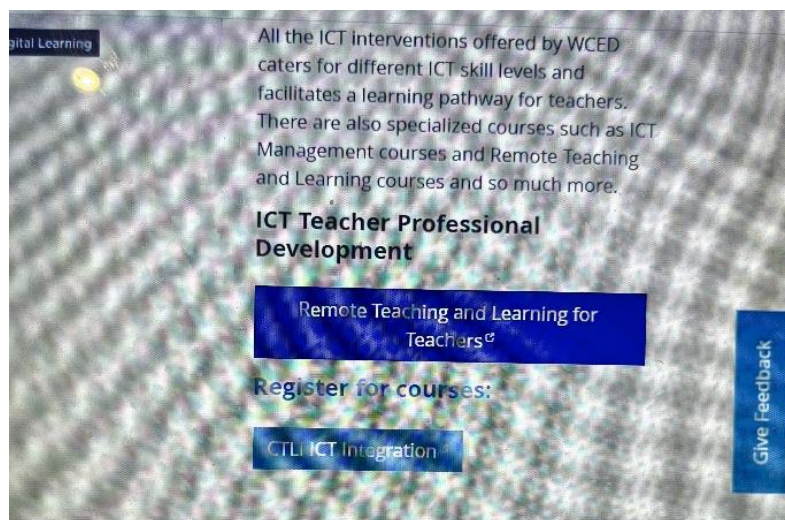


Figure 0.10: Online teacher development

The workshop was held and led by the study coordinator, who equipped the team to create assessments using tablets. It further outlined how to choose different cognitive levels to test learners. The subject advisor taught teachers how to develop assessments that provide feedback and again teach concepts that learners do not understand until they master them. Together with the HoD, the coordinator facilitated the creation of the evaluation conducted through the tablet. These workshops are also included as part of

teachers' development Quality Management System for the continual development of teachers.

4.3.4 Solutions to collaborative learning and participation

Collaborative learning has different benefits once used in a mathematics classroom. Firstly, it improves problem-solving skills through social interaction in groups and peers. it also promotes diversity, inspires creativity, creates trust, improves confidence and encourages engagement. Collaborative learning was proven effective when adding and subtracting numbers using tablets in groups and with peers and maintaining discipline among learners. Most of the learners were excited and learned a great from their peers.

The team asked the administration and a team member who is a parent to conduct a workshop on collaborative learning. The administration helped most with the creation of WhatsApp groups and trained teachers in doing videos that explain the homework to learners' parents. The teachers were trained extensively in combining a paper and video combinations. The study coordinator facilitated how teachers can apply collaborative learning in class using tablets, especially peer and group teachings. Furthermore, it provided the team with an online learning site that could be used to collaborate in learning mathematics, where teachers are advised to advance their skills as the world changes through the website.

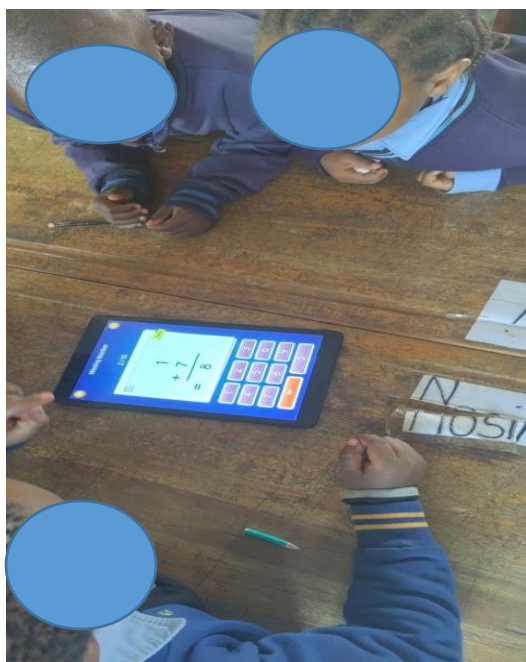


Figure 4.3.4 : Addition in groups using tablet

4.3.5 Solutions to teaching mathematics involving real-life situations using tablets

To utilise real-life situations in mathematics fosters logical reasoning and analytical thinking, particularly when addressing problems related to money, mass in food preparation, fractions in the context of sharing and dividing and measuring distances (Papadakis et al., 2021:6). Moreover, the incorporation of real-life scenarios into mathematics education nurtures flexible thinking and creativity by engaging learners in diverse concepts, thereby enhancing their investigative skills, resourcefulness and creativity (Mwapwele, Marais, Dlamini & Van Biljon, 2019:18).

Upon the team's request, the subject advisor was enlisted to provide insights into the importance of connecting real-life situations with the learning of mathematics. Subsequently, the team attended a workshop to learn how to integrate these concepts with tablets. Teachers also participated in a workshop organised by the MSTA to gain further knowledge on integrating real-life situations into the teaching of mathematics. In addition, the team sought guidance from a teacher from a neighbouring school, inviting them to share insights on integrating mathematics into real-life situations. This ongoing

teacher development process will continue within the school and across various platforms to ensure a thorough mastery of this valuable skill.



Figure 0.11: Online development in a real-life situation

4.4 ANALYSING CONDUCTIVE CONDITIONS TO ENHANCE THE LEARNING OF MATHEMATICS IN GRADE 1

In this section, we look at the conditions conducive to enhancing the learning of Grade 1 mathematics. We look at factors that made it possible for the strategy to be effective and implemented. It dwells much on positive engagements the research team drove or executed. The conditions were conditions conducive to creating lesson plans that integrate tablets, (ii) conditions conducive to knowledge-building and facilitation using a tablet, (iii) conditions conducive to the creation of assessment using a tablet, (iv) conditions conducive to collaborative learning and learners' participation using tablets, (v) conditions conducive to involving real-life situations using tablets in mathematics. The above conditions are discussed in depth below.

4.4.1 Conditions conducive to creating lesson plans that integrate lesson outcomes in tablets

The strategy's success becomes evident when there is support from all involved parties who believe and are willing to contribute actively to its effective implementation. The CAPS policy (DBE, 2011:4) encourages positive engagement from all school stakeholders for effective teaching. An active learning style encourages participants to

engage in investigations, discussions and strategy creation to address learning problems. Previous research underscores the importance of involving stakeholders and the entire school community to implement ideas successfully (Tan & Chua, 2023:194).

The principal approved the school's payment of transportation fees for a teacher from another school to impart the skill of integrating lesson plans in tablets to the team. Despite disrupting planned tasks, the SMT allowed the workshops to take the risk in anticipation of positive results. The administrative clerk demonstrated patience with each team member, particularly teachers lacking skills in MS Office. The teachers proactively took the initiative to develop themselves and one another to enhance the learning of Grade 1 mathematics using tablets.

Posthumanism emphasises the significance of entanglements, and in the mentioned conditions, the collective efforts of all team members made it possible. The results of the strategy are reflected in their positive work. As knowledge is distributed, individuals become empowered and in control, as emphasised by CDA. Both teachers and the team felt knowledgeable and gained confidence in planning lessons using tablets (Fairclough, 2023:12). Connectivism underscores the adaptation of teaching and learning through modern digital methods.

4.4.2 Conditions conducive to building knowledge and facilitation using tablets

Following the CAPS Policy, the construction of knowledge in mathematics is crucial for developing reasoning and critical thinking skills, enabling learners to solve problems effectively by mastering mathematical concepts. The careful selection of relevant tablet software and applications is essential. It is designed to engage learners in meaningful learning processes and align content with the curriculum, ensuring its appropriateness for knowledge development (Chisango & Marongwe, 2021:152). To solve equations or acquire knowledge, learners must possess a concrete understanding of mathematics and choose different methods, where tablets play a significant role in developing diverse problem-solving strategies. Furthermore, having a foundation in mathematical knowledge allows learners to apply this knowledge in various aspects of life.

Conditions became conducive when a subject advisor agreed to conduct workshops for teachers on knowledge-building using tablets, integrating them in different mathematics policies that encouraged teachers to maintain alignment with policies even when using tablets. Facilitation led by the HoD, with the support of team members, made it clear for teachers to understand the expectations while building mathematics knowledge using tablets.

Posthumanism, as an enlightening force, progresses from less information and empowers beneficiaries; teachers benefit from knowledge-building skills using tablets through ongoing development. CDA was applied using tablets to significantly expand teachers' knowledge, allowing them to explore different sites for practical information. Connectivism encourages the understanding of how and where to find knowledge through networks, successfully applied to help teachers discover various helpful applications that align with CAPS.

4.4.3 Conditions conducive to creating assessments that integrate tablets

Evaluation stands out as the pivotal aspect of learning, yielding comprehensive insights into the effectiveness of all teaching. It elucidates deficient skills that require reinforcement and identifies those that have been successfully mastered. Similarly, tablet-based assessments promote active engagement among learners, enabling teachers to monitor each learner's needs and participation, fostering the development of independent learners (Schult, Mahler, Fauth & Lindner, 2022:545). Moreover, assessments contribute to achieving projected objectives and goals, facilitating academic accomplishments through practising and mastering concepts for optimal results using tablets (Khoza & Biyela, 2020:2668).

The team's proactive engagement prompted them to recognise the need to invite teachers from another school with tablet experience to conduct a workshop on integrating tablets during assessments. The teacher from the neighbouring school facilitated the acquisition of new skills for teachers, guided them in creating assessments, provided feedback using tablets, and reinforced the understanding of cognitive levels, especially for the HoD. The

administrative clerk also dedicated time to instruct teachers on administering papers, particularly questions about fractions.

Posthumanism reflects autonomy, where the research team identified their skills gaps and endeavoured to develop them to align with contemporary teaching practices involving tablets. CDA played a role as every team member took ownership of discovering ways to enhance assessments using tablets. Connectivism encourages the pursuit of knowledge through networks to refine assessment techniques using tablets.

4.4.4 Conditions conducive to collaborative learning using tablets

Engaging in collaborative learning in mathematics yields numerous benefits, fostering the development of various mathematical skills, including problem-solving, critical thinking, and social interaction skills (Warsah, Morganna, Uyun, Afandi & Hamengkubuwono, 2021:446). Similarly, collaborative learning promotes diversity, as group learning involves individuals with different skills and cultures. Learning mathematical concepts in such a setting enhances tolerance among peers and provides an opportunity to learn from others. Tablets are pivotal in facilitating collaborative learning by enabling learning from different locations, whether with peers or teachers, using platforms like SharePoint, MS Teams, WhatsApp, among others.

Conditions for collaborative learning using tablets were established with the support of the principal, who approved the creation of a WhatsApp group for Grade 1 parents to monitor learners' homework and arranged for Wi-Fi installation in the school for seamless operations (Naidoo & Hajaree, 2021:846). The administrative staff assisted in registering parents' numbers individually, ensuring a smooth process. Team members also implemented tablet parent control measures to protect learners from exposure to harmful sites. However, challenges arose due to some parents not having smartphones or WhatsApp, but strong community cooperation emerged as neighbours assisted one another in sharing essential information.

Posthumanism emphasises interdependence, which is evident in the active cooperation demonstrated when assistance is needed, which is reflected in the collaboration for the

success of the strategy, empowering parents, teachers, and learners through development initiatives to excel in peer tutoring, collaborative teaching, and problem-solving in mathematics, as advocated by CDA. Connectivism underscores the idea that learning is more critical than knowing, highlighting the practical application of knowledge by testing WhatsApp group learning effectiveness when using tablets. In this way, knowledge is actively applied.

4.4.5 Conditions conducive to using real-life situations in mathematics using tablets

Incorporating real-life situations into mathematics instruction enhances learner engagement, fostering the acquisition of diverse skills and concepts as they find relevance in these situations. This approach encourages creativity and analytical thinking as learners connect with the real-world context and apply their knowledge (DBE, 2018:9). In addition, it promotes critical thinking when solving problems associated with practical scenarios, such as budgeting, instilling skills in prioritization and financial management. Real-life situations thus contribute to the development of effective problem solvers. Tablets are vital in bringing the outside world into the classroom, overcoming the limitations of requiring learners to get physical resources from home. Tablets facilitate access to diverse resources from different aspects of life, enriching learners' mathematical knowledge (Robberts, 2021:138).

The collaboration between the SMT and the research team facilitated the identification of relevant websites that support teachers in integrating real-life situations into mathematics using tablets. The commitment of the SMT was evident in allowing teachers to attend a week-long MSTA workshop, with the school covering transport costs and entrusting learners to the SMT's care during their absence. The subject advisor also played a crucial role by devising a development program to train teachers on incorporating real-life situations into the learning of mathematics using tablets, demonstrating patience that facilitated seamless understanding.

Posthumanism advocates relationality, and emphasises the influence of knowledge derived from society, culture, and the environment on mathematics creativity and logic

(Mahlomaholo, Israel & Mahlomaholo, 2023:6). The equal engagement between teachers and the SMT fosters a teachable environment, equipping them with previously lacking skills. Connectivism comes to the fore when information is drawn from the internet, empowering the research team with enthusiastic teaching skills (Thoma et al., 2023:1).

4.5 IDENTIFICATION OF POSSIBLE THREATS WHEN USING TABLETS TO ENHANCE THE TEACHING OF MATHEMATICS IN GRADE 1

This section focuses on the possible risk of strategy implementation and how it could be avoided for effective enhancement of the learning of mathematics in Grade 1 using tablets. During the meeting for reflection, the team identified the following challenges: (i) threats creating lesson plans that integrate tablets, (ii) threats to knowledge-building, (iii) threats to the creation of assessments using tablets, (iv) threats to collaborative learning using tablets, (v) threats to involving real-life situations using tablets in mathematics.

THREATS TO THE CREATION OF LESSON PLANS THAT INTEGRATE LESSON OUTCOMES WITH TABLETS

The primary challenge identified was the lack of tablet usage skills among teachers. According to the E-Learning Policy (DBE, 2020:25), teachers are expected to be ICT-friendly and proficient in utilizing various application software for teaching with tablets and computers. Previous research indicates that many teachers in South Africa are not familiar with tablet usage, with some neglecting their significance and others expressing no interest in incorporating them into their teaching practices. Learning theories emphasise the importance of well-planned lessons with specific goals, outcomes, and skills to be achieved, and incorporating different resources such as tablets, aids learners in reaching these projected outcomes.

To address this challenge, the research team employed posthumanism, which encourages relationality, and Participatory Action Research (PAR) to enhance teachers' tablet skills. Power distribution occurred as teachers felt empowered by the tablet application skills they developed, supported by Critical Discourse Analysis (CDA). The

expansion of teachers' knowledge through the use of networks exemplified the principles of connectivism.

4.5.2 Threats to building knowledge and facilitation using tablets

The challenge emerged in selecting applications aligned with the CAPS Policy, as many mathematics software options did not adhere to the specific aims outlined in the policy, which is fundamental to our teaching requirements. According to Chisango and Marongwe (2021:150), teachers face difficulties in utilizing applications that align with the CAPS document when teaching mathematics. Learning theories emphasise the importance of aligning knowledge development with specific aims and skills required for learners (Mwapwele et al., 2019:8).

Despite these challenges, the team successfully executed the plan by dedicating time to research mathematics application software that aligns with the CAPS Policy and its specific aims. The entanglement between the curriculum and applications enabled the team to select relevant and effective options. The power of research tools enabled the team to make informed decisions about specific software choices. Nurturing connections facilitated continuous learning for core researchers in knowledge-building.

4.5.3 Threats to assessments using tablets

The challenge that emerged prominently was the specificity of cognitive levels in tablet assessments. The CAPS Policy (DBE, 2011:485) outlines the correct utilization of various cognitive levels to address all learners' diverse needs and abilities. Previous research indicates that teachers struggle to select assessments that incorporate different cognitive levels to evaluate varied learners' abilities, often limiting assessments to only one or two levels (Chetty-Mhlana, Fuhrmann, Basera, Eeftens, Rösli & Dalvie, 2021:1). Learning strategies guide learners through different levels of knowledge primary, intermediate, and mastery stages and emphasise exposing learners to all these levels to assess their capabilities (Saal, Reyneveld & Graham, 2019:3).

Posthumanism, characterised by entanglement, illustrates that lower cognitive levels are the foundation for higher-order thinking. The ability to differentiate between all cognitive

levels and apply them effectively on tablets represents empowerment. To teach learners involves progressing from lower to higher cognitive levels, and acquiring the necessary skills is facilitated through specific assessments.

4.5.4 Threats to collaborative learning and participation using tablets

Concerns regarding collaborative learning highlighted the exposure of learners to potentially harmful sites. The E-Learning Policy (DBE, 2020:40) explicitly prohibits exposing learners to sites that contain violent, bullying, racist or other inappropriate content. Previous research indicates that many learners engaged in collaborative learning using tablets have experienced cyberbullying and unwanted exposure to content like pornography (Fourie, 2021:229). The aim of learning should be to protect and enhance mathematical skills by utilizing resources that are not harmful and ensuring learners are on platforms where they can comfortably learn.

Posthumanism and PAR emphasise collaborative development, wherein learners, teachers and parents actively participate in the learning process, fostering growth in both social and educational aspects (Mahlomaholo et al., 2023:7). CDA was implemented when the team exercised their authority to employ parental controls with regard to tablets, preventing access to harmful sites. The connectivity of the tablets to parental control tools increased vigilance and reporting on potential harmful sites, enhancing collaboration,

This concern was addressed through the implementation of parental control tools with regard to tablets.

4.5.5 Threats to involving real-life situations in fractions using tablets

A prominent concern revolved around time management skills, as CAPS (DBE, 2018:5) has allocated specific timeframes for various fractions content in mathematics. The apprehension about activities involving real-life situations stemmed from the perception that they might require an extensive understanding and, consequently, a significant amount of time. Previous research has indicated that the use of tablets could lead to time wastage, particularly during the introduction stage of teaching mathematical concepts,

such as fractions. Learning strategies advocate effective time utilization, emphasizing time on task and comprehensive content coverage.

Posthumanism promotes critical learning by engaging learners with elements they can relate to, fostering creativity and enabling them to approach problem-solving with enthusiasm. The effectiveness of real-life situations in enhancing mathematical concepts hinges on the accurate application of knowledge and adherence to specific guidelines. Connectivism comes into play when learners can connect their daily life experiences with mathematical concepts, thereby becoming creative and critical problem solvers (Boyras & Ocak, 2021:1125).

To address this concern involved meticulous planning and ensuring the specificity of tasks undertaken.

4.6 EVIDENCE OF SUCCESSFUL STRATEGY TO ENHANCE LEARNING OF GRADE 1 MATHEMATICS USING TABLETS

This section presents positive evidence of the strategy researched, analysed and implemented to enhance the learning of mathematics in Grade 1 using tablets. According to previous information, learning strategies, methods, and using tablets as a resource were improved. Still, in this section, we see the application of knowledge acquired as evidence of success. The evidence of success is shown in these objectives: (i) evidence of success in creating lesson plans that integrate tablets, (ii) evidence of success in knowledge-building, (iii) evidence of success in the creation of assessments using tablets, (iv) evidence of success in collaborative learning using tablets, (v) evidence of success in involving real-life situations using tablets in mathematics. The above evidence of success is discussed below.

4.6.2 Evidence of success in creating lesson plans that integrate tablets

The DBE (2011:36) underscores the significance of a well-structured mathematics lesson, highlighting that effective planning contributes to successful learning outcomes. A meticulously planned lesson should clearly articulate instructional methods towards

goals, and allocate specific time for coverage. The research underscores the importance of lesson planning that integrates tablets, facilitating learners' acquisition of mathematical concepts. This approach encourages the development of various skills, fosters positive attitudes, and ensures a profound understanding of mathematical content. Learning theories advocate thorough lesson planning, emphasizing the use of diverse technological resources to stimulate learners' creativity and suggest alternative problem-solving approaches.

Grade 1 Lesson Plan		
Subject: Mathematics	Duration: 1 Hour	Topic: Count, compare and add
Concepts and Skills		
- Count objects up to 10 playing music on tablet - Compare more or less Activity 3 on Tablets - Recognize, identify and read numbers : use quizzes on tablets - Solve verbal estimated problems		
Activities		
Activity	Can the learners	Observation
In their tablets they play a dice game. Then count the number rolled, then throw again and start comparing if the new number is more or less than previous	count objects up to 10	Checklist
Compare objects on the tablet activity by choosing according to instruction	Compare objects using words more than, less than or equal to	

Figure 0.12: Lesson plan integrating tablets

Posthumanism involves decentralization, transitioning from limited information to vast expanses. The strategic planning of lesson plans integrating tablets serves to decenter resource limitations, allowing for the extensive incorporation of mathematical knowledge through tablets (Hasse, 2020:6). The application of CDA empowered teachers through tablets, expanding resources to more potent, interactive, and engaging formats for learners, including the use of colours, music, and videos. Connectivism aligns with fostering learning growth by connecting to various networks and devices to enhance mathematical knowledge.

4.6.3 Evidence of success in knowledge-building and participation using tablets

The development of knowledge is crucial in mathematics, as a well-established knowledge base empowers learners to generate and apply knowledge, showcasing creativity and critical skills (DBE, 2018:38). Studies indicate that learners with a robust understanding of numerical concepts, measurements and shapes can effectively comprehend questions and solve mathematical problems presented in tablet quizzes or puzzles. Piaget's perspective underscores that social and physical knowledge is acquired from external sources such as tablets. In contrast, logical knowledge is aligned with internally constructed understanding, implying that tablets can instruct, reinforce, and advance acquired knowledge.

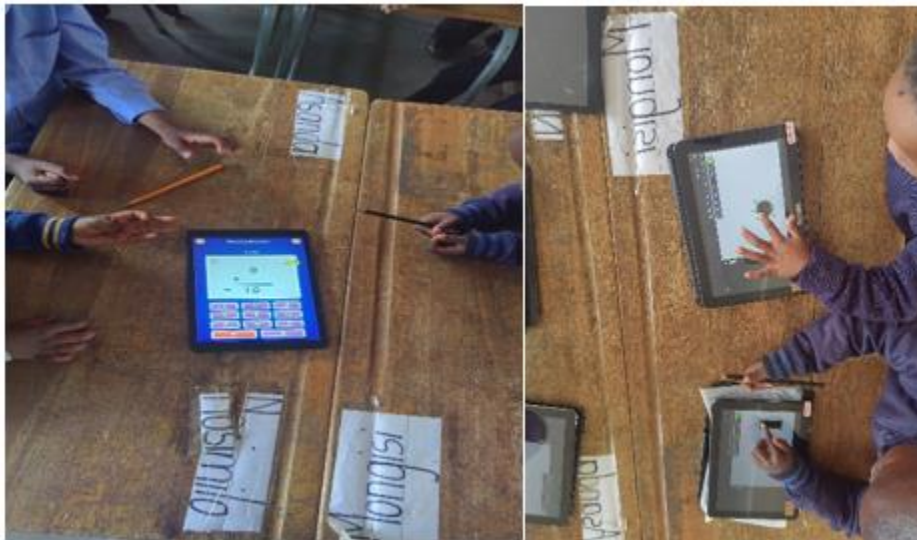


Figure 0.13: Building knowledge using tablets

Posthumanism opposes the concept of enlightenment. Consequently, the prohibition of learners from utilizing tablet applications that can enhance their knowledge and skills for analysing and interpreting mathematical problems is discouraged (Hasse, 2020:6). CDA is an analysis with a problem-solving orientation linked to the social history in mathematics academia. The enhancement of learner performance was noted after the implementation of the strategy (Fairclough, 2023:15). Connectivism underscores the connection between people and knowledge through online training and the utilization of tablet applications, facilitating knowledge acquisition for both learners and teachers.

4.6.4 Using tablets in assessments

The use of tablets for mathematics assessments offers numerous benefits, engaging learners in an exciting game-like format that integrates various contents and subjects (Papadakis et al., 2021:8). Previous research underscores the importance of selectively choosing tablet apps for assessments, ensuring alignment with the taught content to foster creativity in learners (Outhwaite, Faulder, Gulliford & Pitchford, 2019:284). According to Ten Braak, Lenes, Purpura, Schmitt, and Storksen (2022:214), learners assessed by a trained teacher using technology in a learner-centred approach, coupled with sound mathematics knowledge, tend to become independent learners and excel in academic matters.

The focus was on educational relationality, which entails decentering teachers as the sole source of information and centring technological tools like tablets, the learning environment, and non-human elements on enhancing learner performance through proper assessment principles (Bakos, 2023:15). CDA aims at illustrating how social occurrences are interconnected in knowledge production, enabling knowledge generators to emancipate from power dynamics through self-reflection (Farrelly, 2020:360). Connectivism underscores the importance of connectedness and interactivity, signifying that connections between people and people and technology can enhance learners' mathematical knowledge applicable during assessments (Omodan, 2023:4).



Figure 0.14: Assessments using quizzes on tablets

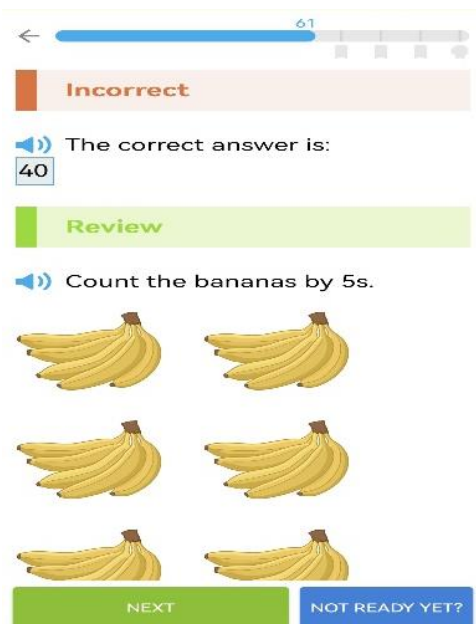


Figure 0.15: Giving speedy feedback

Learners found assessment using tablet game boards, quizzes and puzzles engaging and stimulating to various senses of perception. Using other manipulative allowed learners to apply, analyse and solve given problems successfully.

4.6.5 Evidence of success in using tablets in collaborative and participation learning

The DBE (2018) promotes the active engagement of learners in the learning process, emphasizing the positive outcomes of practical group work and peer teaching. Research indicates that leveraging social media platforms like YouTube, WhatsApp, TikTok, and others has yielded positive results in collaborative learning, particularly in activities related to numerical operations such as addition, multiplication and division (Ansari & Khan, 2020:3). Collaborative learning fosters positive interdependence, wherein learners recognise their interconnectedness with one another and with technology. Consequently, to nurture these relationships is crucial to achieving high performance in mathematics (Sibanda & Rambuda, 2021:301).



Figure 0.16: Collaborative learning using a tablet



Figure 0.17: Collaborative Learning on YouTube

Posthumanism emphasises entanglements that people and non-humans have to contribute to the development of knowledge; it further stipulates the relationality that is possessed by learners with other learners and in using tablets to interlink and increase performance (Hasse, 2020:5). Learners were amenable to peer and group teaching, used different technological media in a tablet to improve their mathematical knowledge and valued the need of helping each other and using a tablet. The social level of CDA motivates interest and understanding of social concerns that prevented people from getting required knowledge; the tablet and interactions of learners led to positive performance in mathematics (Fairclough, 2023:17). The learning of Connectivism in classrooms occurs better when connection and interrelationships between people, tablets and knowledge are combined and produces high performing learners in mathematics, Therefore, in connectivism learning is dependent on humans and non-humans (Siemens, Rudolph & Tan, 2020:108).

The use of tablets in groups, with peers, and online learning increase learners' performance, and they become active participants in all learning platforms. The use of tablets allows learning everywhere at any time.

4.6.6 Using tablets when learning mathematics involving real-life situations

To teach mathematics through real-life situations imparts meaning and context to learners' education, establishing connections between their mathematical knowledge and everyday experiences (DBE, 2018:32). Research supports the notion that incorporating real-life situations into mathematics instruction is impactful, with learners demonstrating better understanding and performance in **world** problems related to their lives. Vygotsky's learning theory **says** that acquiring mathematical knowledge transpires through linking prior knowledge with new mathematical language, creating meaningful learning experiences for learners.



Figure 0.18: Real-life situations on tablets

The posthumanism perspective posits that learning extends beyond the mere acquisition of knowledge and skills; it involves embodied experiences where learners engage with their environment and make sense of these experiences through a relational process with tablet applications. Applying Fairclough's ideology, data was analysed in discursive practices that contributed to mitigating unequal power relations. The effective utilization of tablets in mathematics bridges the inequality gap. Connectivism suggests that learners should integrate thoughts, theories, experiences, and external networks, and using tablets or links facilitates this connection with mathematical learning.

The utilization of tablets for learning mathematics concepts, particularly real-life situations such as fractions, mass, length, and data handling contributes to developing learners'

problem-solving skills and critical thinking. These acquired skills can then be applied in various real-life situations.

4.7 CONCLUSION

This chapter focused on the strategy designed to improve Grade 1's learning of mathematics using tablets at a school in Mkhondo. The presentation and interpretation of findings and conclusions drawn from data analysis were discussed in alignment with the study's objectives outlined in Chapter 1. A rich dataset, encompassing photos of learner activities and discussions from research team meetings, was employed to underscore the necessity of formulating this strategy. The collected information brought to light challenges encountered in enhancing Grade 1's learning of mathematics through tablet usage. Strategies to overcome these challenges and facilitate the improvement of learning mathematics using tablets were explored. Co-researchers also evaluated various conditions crucial for the success of the plan. Anticipated hurdles to the strategy's success were identified and addressed.

The proposed solutions to challenges were implemented mostly in teachers of the school at Mkhondo using the resources that were prescribed by the collective. These solutions were found attainable as they were designed to suit the needs of teachers and learners according to resources that are accessible to them. The main focus in implementing these solutions was to improve the learning and teaching of mathematics in Grade 1 using tablets available at the school. In terms of Wi-Fi connections the school only had to reconnect as it was provided by the Department. Teachers were then able to access the internet for training or development, downloading and applications. The findings point to the power of collaboration, showcasing the creative and innovative potential that emerges when working collectively to develop teachers and effective strategies for enhancing mathematics using tablets.

CHAPTER 4

SUMMARY OF FINDINGS, RECOMMENDATIONS AND CONCLUSION

5.1 INTRODUCTION

The presentation, analysis, and interpretation of data collected using PAR in the previous chapter were structured around the five objectives of the study mentioned in Chapter 1. This study aimed at designing a strategy to enhance the learning of Grade 1 mathematics using tablets at a school. A summary and discussion of findings is now being presented. So are recommendations for further research.

5.2 FINDINGS AND DISCUSSION

The study had five objectives. They are the following,

1. To investigate the challenges of enhancing the learning of mathematics using a tablet in Grade 1.
2. To explore solutions to the challenges of enhancing the learning of mathematics in Grade 1.
3. To analyse conducive factors for enhancing the use of tablets in the learning of mathematics Grade 1.
4. To identify possible threats of using tablets in teaching Grade 1 mathematics.
5. To investigate whether the solutions to the challenges that are acknowledged are operative.

5.3 CHALLENGES TO ENHANCING LEARNING OF GRADE 1 MATHEMATICS USING TABLETS

5.3.1 Teachers are not able to plan lessons that integrate lesson outcomes and tablets

The findings indicate that teachers faced challenges in formulating lesson plans that incorporate tablets and align with learning outcomes. This became apparent during a

reflective meeting where teachers and co-researchers examined four lesson plans from a Grade 1 teacher. Tablets were not actively utilised in the lessons leading to the creation of plans that did not integrate tablets and consequently affected the lesson's effectiveness in achieving subject learning outcomes.

Mrs Kunene's reluctance to use tablets stemmed from a lack of technological skills, preventing her from planning lessons that incorporated tablets and aligned with learning outcomes. Consequently, there was a recognised need for skill development in tablet usage and integrating lesson plans with learning outcomes to enhance students' mathematical knowledge.

Discussions prompted by the study's findings and the alignment with similar findings in studies from other countries underscore the challenges teachers face in creating lesson plans that integrate tablets, often attributed to inadequate technological skills. Posthumanism's theoretical and conceptual framework played a pivotal role in structuring the study framework and providing additional support for the proposed strategy. Recognizing the importance of integrating tablets and learning outcomes in lesson plans becomes crucial for advancing Grade 1's learning of mathematics. Insufficient skills in using technology and integrating tablets with learning outcomes have substantial implications.

5.3.1.1 Recommended strategies for creating lesson plans that integrate tablets with learning outcomes.

Teachers were equipped with crucial skills, encompassing the development of lesson plans, proficient tablet usage and seamless integration of lessons with learning outcomes. The administrative clerk, supported by the librarian, led the training sessions, concentrating on technological skills such as MS Office, Adobe documents, and internet access. The mathematics subject advisor facilitated a workshop to integrate learning outcomes with tablets. Experienced teachers conducted workshops, offering foundational knowledge for crafting effective lesson plans. Teachers from neighbouring schools, well-versed in tablet use, shared insights on integrating lesson plans with learning outcomes

using tablets. In addition, teachers actively sought online resources for skill development, exploring platforms such as My e-Learning World and Teaching Training Together.

The study points to the importance of meticulously planning lessons and seamlessly integrating tablets, ensuring alignment with learning outcomes through relevant applications to enhance Grade 1's learning of mathematics. This approach empowers teachers to create transformative lessons and establish conducive student learning environments.

5.3.2 Lack of knowledge-building and facilitation using tablets

Developing mathematical knowledge and facilitating effective learning can pose challenges for teachers. Teachers must be well-versed in the expected outcomes of the CAPS curriculum for each grade, comprehend fundamental concepts and possess adept facilitation skills. The literature review in Chapter 2 highlighted the fact that teachers still lack the skills to foster mathematical knowledge using tablets, resulting in a significant failure in mathematics education.

Research indicates that inadequate knowledge development in mathematics can hinder learners from applying their knowledge to problem-solving making connections between prior and new knowledge. Facilitation is crucial for achieving high performance in mathematics, as teachers play an active role in listening and monitoring progress. Tablets provide a conducive and understandable platform for facilitating learning, allowing learners to effectively produce and expand their knowledge.

5.3.2.1 Recommended strategy for knowledge-building and facilitation using tablets

During the data collection process, co-researchers acknowledged the concerns expressed by teachers regarding their lack of skills in building knowledge and facilitating learning using tablets. The study suggested that teachers enhance their knowledge through game-based learning aligned with CAPS. In addition, it recommended the incorporation of mathematics into daily life through regular skill practice to achieve

targeted knowledge and skill mastery. The study also advised teachers to adopt a more learner-centred approach to facilitate learning, utilizing tablets to extend learning environments and challenge learners for skill advancement.

The team recommended online learning for teachers to acquire skills in developing knowledge. Subject advisors and experienced teachers were proposed as valuable resources to assist in developing teachers' skills in building knowledge and facilitating learning using tablets.

5.3.3 Teachers not using tablets when doing assessments

Upon analysis, it was discovered that teachers face challenges in conducting assessments using tablets. They struggle to choose activities aligned with CAPS that assess learners' abilities across various cognitive levels, from applying knowledge to the highest point of Bloom's Taxonomy where they can create. This results in inadequate assessments that fail to cultivate creative thinking, generative speculation, and critical thinking with analytical and logical components. Previous research highlights teachers' difficulties in creating assessments that enable them to evaluate learners' strengths and weaknesses on specific topics, provide feedback using tablets and enhance learner progress.

Furthermore, school teachers struggled to create tablet-based assessments with clearly defined measurable learning outcomes and appropriate instructions. In line with posthumanism, the emphasis is on social justice and fairness, indicating that learners should receive comprehensible assessments that align with their studies. Connectivism supports the extension of the learning environment to foster the development of high-level skills during assessments.

5.3.3.1 Recommendations on conducting assessments using tablets

The progress made in this study to enhance teachers' ability to create meaningful assessments is promising. If teachers can produce assessments that align with CAPS,

assess various cognitive levels, and empower learners to effectively apply knowledge, facts, and data to solve problems that can be helpful.

Teacher development should involve those with experience in using tablets for assessments, utilizing online platforms such as departmental workshops for mathematics and programs commonly advertised on SACE CPTD and the Tablet Academy. It is recommended that teachers conduct pre-checks on assessments to ensure that specified outcomes are met. Developing skills to create assessments that enable teachers to provide feedback on tablets for each learner establishing a connection between learners' tablets and teachers' tablets is crucial. Installing applications that track learner performance allows teachers to address areas where students may need additional support.

5.3.4 Challenge in collaborative learning and participation using tablets

The study revealed that teachers face challenges in implementing collaborative learning and enhancing learner participation through using tablets in mathematics. Teachers voiced some difficulty in executing collaborative learning with tablets, noting that many learners stay within their peer groups thus limiting their active involvement. Observable low performance was noted during group activities and was attributed to the students' lack of collaborative skills.

Similarly, learner performance dropped when assigned homework, with many students failing to complete assignments due to inadequate communication skills or difficulty in following instructions. Analysis of learner activities confirmed this issue. Previous research also highlighted below par performance in team-based learning, peer tutoring and study groups, citing a lack of participation and tablet skills. Learners tended to work individually without relying on their peers, parents or group members. Based on the findings some actions are recommended and will now be discussed.

5.3.4.1 Recommendations on collaborative learning and participation using tablets

The study suggests that the strategy's effectiveness hinges on developing teachers' skills in using tablets. The team collaborated to strengthen teachers by selecting and installing applications that support collaborative learning, ensuring each learner's active In addition, the study recommends that these improvements align with the CAPS Policy, considering whether the applications are in line with the projected year plan for Grade 1 mathematics. Furthermore, the teaching and learning process in collaborative learning should be monitored to prevent discrimination based on factors such as race, disabilities, and gender, among others. Similarly, the use of social platforms for group learning should be supervised by teachers and parents to prevent learners from being exposed to unwanted content and cyberbullying.

5.3.5 Teachers not using tablets when teaching mathematics content that involves real-life situations

The study revealed that by using tablets, teachers faced challenges in teaching mathematics topics involving real-life situations such as fractions, mass and money. Teachers preferred to use concrete objects instead of tablets for these topics, and even encouragement from the SMT did not motivate them to use tablets, something that led to consistent underperformance. This underperformance was evident in the learners' activity books and analysis of these specific topics.

Despite analysis and improvement plans for the subject, the teaching approach remained unchanged, with no shift in the use of resources resulting in continued failure. Learners often became disengaged and bored, distancing themselves from learning these content areas due to complex terminology and instructions. Consequently, the enhancement of Grade 1's learning of mathematics was not achieved.

5.3.5.1 Recommendations for using tablets when teaching mathematics content that involves real-life situations

The study recommends that the team utilise tablets for content areas involving real-life situations to enhance Grade 1's learning of mathematics. To achieve success, both the team and the school should recognise the potential of tablet applications in improving mathematics education. Research indicates that many households in South Africa own tablets, but they are not widely utilised for learning mathematics. Therefore, there is a need to shift the current usage pattern of tablets and incorporate them into the learning process.

Furthermore, the study proposes a learner-centred approach to tablet-based learning, where learners actively participate in their educational experience. It encourages teachers to move away from traditional teaching methods focused on terminology and, instead, engage learners with quizzes, games and puzzles while addressing areas lacking clarity. In addition, the study suggests that schools explore ways to increase their resources and call for collaboration between parents and the school to ensure proper utilization of tablets.

5.4 STRATEGIES FOR ENHANCING LEARNING OF GRADE 1 MATHEMATICS AT A SCHOOL (Name the school)

This study focuses on enhancing Grade 1's learning of mathematics using tablets at a school in Mkhondo through a Participatory Action Research approach. The enhancement strategies encompass various tablet features, interactive mathematical games, and applications to enrich learning experiences. In addition, it involves identifying applications that align with learning goals and foster digital connections across different mathematical content areas. These strategies engage learners' senses, facilitating their ability to remember, understand, apply, analyse, evaluate and create knowledge.

Challenges arise when teachers do not incorporate tablets in knowledge-building activities, face difficulties in integrating lessons with learning outcomes and lack proficiency in using tablet applications. This impacts on the overall effectiveness of the learning environment. Insufficient content knowledge and the inability to link content objectives with tablets further hinder the strategy's success. The study investigates and manages the conditions essential for strategy success while addressing observed challenges. Success indicators play a pivotal role in determining the overall success of the strategy. Critical components for designing a successful strategy to enhance Grade 1's learning of mathematics using tablets include teacher development on tablet usage, effective integration of tablets with content and alignment with learning outcomes.

5.5 RELEVANCE OF THE STUDY

The study is pertinent to improving mathematics learning in Grade 1 through using tablets, and benefits those who foster a sustainable future for learners. It aims to contribute to the advancement of Grade 1's learning of mathematics using tablets through an applicable strategy that is easily adaptable, promoting motivation for using tablets in teaching mathematics. The primary objectives include encouraging teachers to incorporate tablets in their teaching practices to cultivate independent learners with problem-solving, communication and critical-thinking skills.

In the current era of learning, digital and ICT skills are considered crucial. Tablets offer opportunities for collaborative learning, blog creation and participation in various online communities. Equipping learners with such skills opens up avenues for expanding their learning networks and enhancing problem-solving abilities in daily life, given the interconnected nature of mathematics with different fields. As a result, the research highlights the importance of ensuring everyone is proficient in ICT skills.

5.6 VALUE OF THE STUDY

The significance of this study lies in the fact that it outlines strategies for enhancing Grade 1's learning of mathematics using tablets, employing the Participatory Action Research

(PAR) approach. The co-researchers, including teachers, learners and parents, actively practised and refined methods to enhance the learning of mathematics using tablets. The study's impact extended to learners, teachers, parents and subject advisors, benefiting the Foundation Phase mathematics quality assurance, policymakers and program developers. It aimed at creating quality technological tools, developing CAPS-aligned mathematical applications, and enhancing teacher proficiency in tablet-based teaching.

The study is particularly relevant for guiding and preparing learners to become adept problem solvers, encourages collaborative learning, fosters creativity and critical thinking and trains teachers in tablet and ICT skills. By empowering teachers with these skills, learners gain independence and become active participants in their education through technological devices (DBE, 2018:13).

The application of PAR facilitated the involvement of all school stakeholders in designing the strategy, allowing them to identify and address their limitations. The team scrutinised limitations in learner activities and teacher lesson plans, particularly in the underutilization or lack of integration of tablets during the learning of mathematics. The team, comprising the administrative clerk and librarian, played a crucial role in developing essential teacher skills, while the librarian encouraged learners to visit libraries for online lessons.

The inclusion of parents in the study has encouraged them to participate actively in their children's learning. Some parents discovered their children's tablet activities and were guided to download recommended applications for educational purposes. Learners who owned tablets brought them to school, thus fostering a sense of community as they shared resources and created a collaborative learning environment to enhance their mathematical skills. The study demonstrated the empowering effect of tablets on learners' perceptions, turning them into high achievers in mathematics and facilitating communication and collaboration. It highlighted the potential for learners to be active agents in their education when allowed to integrate mathematics content with tablets, thereby enhancing their learning of mathematics.

5.7 SUCCESS IN DESIGNING A STRATEGY

The strategy's success aimed at enhancing Grade 1's learning of mathematics through tablet usage was evident in the seamless integration of tablets into the learning process,

ensuring a perfect alignment with learning outcomes and achieving educational and subject-specific goals. The team focused on creating lesson plans that effectively incorporated learning outcomes with tablets, knowledge-building, facilitation, tablet-based assessments, collaborative learning and integrating real-life situations into mathematics lessons. Grade 1 teachers recognised the significance of incorporating tablets into their classrooms to augment the learning of mathematics.

The development of this strategy was a collaborative effort involving all stakeholders. Teachers experienced substantial professional growth, equipping them with the In addition, teachers acquired valuable skills they can apply to foster excellent achievements in mathematics. Teaching with technology encourages learners to become conceptual thinkers, enhances algorithmic skills and cultivates problem-solving abilities (DBE, 2021:20).

Having gained tablet proficiency through the provided training, teachers successfully integrated tablets into their lessons. Moreover, learners demonstrated the ability to independently utilise tablets for learning mathematics, whether individually or collaboratively, thus fostering logical and computational skills and reaching mastery.

5.8 METHODOLOGICAL CONTRIBUTION

Participatory Action Research (PAR) was favoured as the methodology for this strategy. Nhlapho (2021:24) describes PAR as the technique that allows the researcher and co-researchers to work together to find the solution to the challenge they face, and they gather information to change social or environmental issues. This section provides suggestions based on the principles of PAR to improve the learning of mathematics using tablets because it is transformational, empowering, de-colonial, and encourages social justice, hope and peace (Dlamini, 2018:25).

According to the study, both human and non-human have a positive impact in finding the strategy and all their efforts are regarded as fruitful. In PAR, everyone involved collaborates in finding an effective strategy to be used in improving the learning environments by identifying techniques that are conducive (Dube, 2020:136). To answer

to the inabilities of teachers, lacking skills they were trained until they muster these skills as PAR offers practical solutions. PAR allowed teachers to teach confidently as they had skills in integrating lesson plans with tablets, conducting assessments using tablets, building knowledge and facilitating the use of tablets.

Through the use of PAR, this study strengthens the relationship with all stakeholders to work together and develop conducive learning environments. This strategy will still be used to enhance the learning of mathematics using tablets, and it will be activated by those involved, as PAR is grounded in first-hand knowledge.

5.9 LIMITATIONS OF THE STUDY

The use of one school Grade 1 class limited the results as they only depend on this school in all Mkhondo schools that use tablets. The limited resources also limited teachers' ability to use them more frequently as wanted, including Wi-Fi connections. There is less cooperation from curriculum implementers, especially on topics of tablet integration. The presence of authorities such as departmental officials, librarians or principals limited co-researchers from expressing their concerns freely, as they believed that they were much more knowledgeable than them.

Another issue was that this study required more time in the afternoon; learners had to spend more hours, which was exhausting. Most of the co-researchers are also working. They had to sacrifice their time for this strategy to be a success. Money was the other limitation of many workshops attended by teachers who required money. Some applications required subscriptions that required money. This study was done in one rural school in Mkhondo, and this limited its impact.

Future studies should focus on how tablets can influence learners to be high achievers in mathematics if given tablets containing mathematical applications earlier. We look at how children can use a phone or tablet at the very young age of two years; in most cases, no one teaches them how to operate it. They learn on their own. What will happen if correct mathematics content games are installed and how can that develop their mathematical skills in higher grades. Furthermore, the strategy can be used for comparative studies

across different schools and regions - thus providing valuable insights into the contextual factors influencing the effectiveness of tablet integration strategies. Moreover, research focusing on the role of parental involvement and community support in enhancing tablet-based learning experiences can enrich some understanding of this area.

5.10 SUMMARY OF THE STRATEGY

This study demonstrates the necessity of encouraging teachers to use tablets during their lessons to extend their learning. All stakeholders in this study are encouraged to play active roles by determining, measuring, assessing and addressing a specific problem. In all challenges, it easily concludes that PAR plays an essential role in bringing favourable classroom conditions through a framework that helps design an effective strategy to enhance the learning of Grade 1 mathematics. It involves all stakeholders who participate fruitfully in solving all disruptions to improving mathematics using tablets effectively.

The study contends that different challenges delay the implementation strategies to enhance the learning of mathematics using tablets. For this reason, many challenges have been dealt with, leading to the strategy's success. Teachers should apply different teaching methods to implement the strategy to enhance the learning of mathematics using tablets successfully. With that, learners' skills will be improved to levels where they can apply mathematical knowledge to solve problems critically.

In addition, teachers should be developed in using tablet applications through extensive workshops or online learning to advance skills, as they are the facilitators of learning and are responsible for guiding learners to the projected angle of mathematics outcomes for Grade 1. Teachers should also be careful when choosing tablet applications regarding their alignment with CAPS, the activities that push learners to reach for a higher cognitive level. Both parents and teachers should be able to restrict unwanted content on tablets, especially during collaborative learning or online classes. Lastly, the DoE should do awareness workshops on using technology in classes to improve learning, re-visit schools with tablets to encourage its practical use and add resources where needed.

5.11 CONCLUSION

This study aimed to design a strategy to enhance learning of Grade 1 mathematics using tablets at a school in Mkhondo. The background of the study, previous research, policies and learning theory influenced the study's objectives in Chapter 1. The posthumanism lens was used as the guiding theoretical framework, and connectivism was used as the conceptual framework. Furthermore, PAR was the approach used to conduct the study and gather data. CDA was used to analyse data in terms of its three levels: textual, discursive and social.

The enhancement of Grade 1 mathematics using tablets mostly depends on the teacher's knowledge to integrate lessons with tablets. When teachers are well equipped with these skills, this leads to effective learning. Learners become independent and responsible for their learning by exploring networks to connect to large knowledge nodes and be creative thinkers and problem solvers. Different challenges hindered the strategy's success, but these challenges were circumvented through collaborative engagements. Furthermore, learning mathematics should focus not only on humans but also on non-human gadgets. Posthumanism emphasises the relationality of humans with tablets and the environment. Connectivism encourages the importance of connections between people and information through networks and technological gadgets such as tablets to achieve outstanding performance in mathematics.

REFERENCES

Aksoy, M. and Belgin Aksoy, A., 2023. An investigation on the effects of block play on the creativity of children. *Early Child Development and Care*, 193(1):39-158.

Al Falaq, J.S. and Puspita, D. 2021. Critical Discourse Analysis: Revealing Masculinity Through L-Men Advertisement. *Linguistics and Literature Journal*, 2(1):62-68.

Al Maawali, W.S. 2022. Experiential writing through connectivism learning theory: a case study of English language students in Oman Higher Education. *Reflective Practice*, 23(3), :305-318.

AlDahdouh, A.A. 2021. Information search behavior in fragile and conflict-affected learning contexts. *The Internet and Higher Education*, 50 :100808.

Ally, M., 2004. Foundations of educational theory for online learning. *Theory and practice of online learning* 2:15-44.

Anderson-Levitt, K.M. ed., 2022. *Anthropologies of education: A global guide to ethnographic studies of learning and schooling*. **Berghahn Books**.

Ansari, J.A.N. and Khan, N.A. 2020. Exploring the role of social media in collaborative learning the new domain of learning. *Smart Learning Environments* 7(1):1-16.

Appavoo, P. 2021. Acceptance of technology in the classroom: A qualitative analysis of mathematics teachers' perceptions. In *Intelligent System Design* :1-10). Springer, Singapore.

Appavoo, P., 2020. Acceptance of technology in the classroom: A qualitative analysis of mathematics teachers' perceptions. In *Frontiers in Intelligent Computing: Theory and Applications: Proceedings of the 7th International Conference on FICTA (2018), Volume 2* :355-364). Springer Singapore.

Appavoo, P., 2020. The impact of a Technology-based approach for the learning of Mathematics at secondary school level. *Journal of e-Learning and Knowledge Society* 16(4):76-85.

- Atchia, S.M.C. and Chinapah, V., 2022. COVID-19 impacts on digital education in Mauritius: A digital readiness analysis. *KnowEx Social Sciences* 2(01):84-109.
- Attard, C. Calder, N. Holmes, K. Larkin, K. and Trenholm, S. 2020. Teaching and learning mathematics with digital technologies. *Research in mathematics education in Australasia* 2016–2019:319-347.
- Bakos, S., 2023. Mathematics, TouchTimes and the Primary School Teacher: Generating Opportunities for Transitions Across and Beyond. *Digital Experiences in Mathematics Education* 9(1):5-30.
- Barad, K. 2003. Posthumanist performativity: Toward an understanding of how matter comes to matter. *Signs: Journal of women in culture and society* 28(3):801-831.
- Bhaugeerutty, V.S. 2021. Difficulties in learning and teaching programming at lower secondary level in Mauritius. *Journal of Contemporary Research in Social Sciences* 3(3), :48-61.
- Bholoa, A., Ramma, Y., Jawaheer, S., Moheeput, K. and Atchia, S., Transforming Science Education at Grade 9 With a Pedagogical Technological Integrated Medium: An Integrated Approach for Teaching, Learning, and Assessment.
- Bolter, J.D. 2016. Posthumanism. In J.P. Pavlik (Ed.), *The International Encyclopedia of Communication Theory and Philosophy*:1-8..
- Boyras, S. and Ocak, G. 2021. Connectivism: A Literature Review for the New Pathway of Pandemic Driven Education. *Online Submission* 6(3):1122-1129.
- Braidotti, R. 2018. Affirmative ethics, posthuman subjectivity, and intimate scholarship: A conversation with Rosi Braidotti. In K. Strom, T. Mills & A. Owens (Eds.), *Decentering the researcher in intimate scholarship: Critical posthuman methodological perspectives in education* :179-188).
- Braidotti, R. 2019. A theoretical framework for the critical posthumanities. *Theory, Culture & Society* 36(6):31-61.
- Chan, R.Y., Bista, K. and Allen, R.M. eds., 2021. *Online teaching and learning in higher education during COVID-19: International perspectives and experiences*. Routledge.

Chan, S.W., Looi, C.K., Ho, W.K. and Kim, M.S., 2023. Tools and approaches for integrating computational thinking and mathematics: A scoping review of current empirical studies. *Journal of Educational Computing Research*, 60(8):2036-2080.

Chetty-Mhlana, S. Fuhrmann, S. Basera, W. Eeftens, M. Rösli, M. and Dalvie, M.A. 2021. Association of activities related to pesticide exposure on headache severity and neurodevelopment of school-children in the rural agricultural farmlands of the Western Cape of South Africa. *Environment international*, 146 :106237.

Chikiwa, C. and Ludwig, M. 2023. Teaching and Learning with Mobile Technologies. In M. Schäfer (Ed.), *Visualisation and Epistemological Access to Mathematics Education in Southern Africa* :133-157.

Chirinda, B. Ndlovu, M. and Spangenberg, E. 2021. Teaching mathematics during the COVID-19 lockdown in a context of historical disadvantage. *Education Science* 11(4), :177.

Chisango, G. and Marongwe, N. 2021. The digital divide at three disadvantaged secondary schools in Gauteng, South Africa. *Journal of Education (University of KwaZulu-Natal)* (82):49-165.

Choane, M.P. 2021. *Enhancing risk management skills at a municipality using an adult education approach*. Unpublished doctoral thesis. Bloemfontein:. University of the Free State.

Cilliers, J. Fleisch, B. Kotze, J. Mohohlwane, N. Taylor, S. and Thulare, T. 2022. Can virtual replace in-person coaching? Experimental evidence on teacher professional development and student learning. *Journal of Development Economics* 155:102815.

Coles, A. 2022. A socio-ecological turn in mathematics education: Reflecting on curriculum innovation. *Revista Paradigma* 43(1):207-228.

Connectivities, N. 2021. Schooling Education in Mauritius. In P.M. Sarangapani & R. Pappu (Eds.), *Handbook of Education Systems in South Asia* . Cham: Springer.

Corbett, F. and Spinello, E. 2020. Connectivism and leadership: harnessing a learning theory for the digital age to redefine leadership in the twenty-first century. *Heliyon*, 6(1).

Corona, F. Ianniello, A. and De Giuseppe, T. 2020, Flipped Inclusion: An Anthropocentric Ergonomic Model. In *Conference Proceedings. New Perspectives in Science Education 2020*. Available from <https://conference.pixel-online.net/NPSE/NPSE/files/npse/ed0009/FP/6519-EDS4534-FP-NPSE9.pdf> [accessed 25 Jan 2024].

Dehnert, M. 2022. Toward a critical posthumanism for social robotics. *International Journal of Social Robotics* 14(9):2019-2027.

Department of Basic Education (DBE). 2011. *Curriculum Assessment Policy Statement*. Pretoria: Government Printer.

Department of Basic Education (DBE). 2014. *Curriculum Assessment Policy Statement*. Pretoria: Government Printer.

Department of Basic Education (DBE). 2015. *The South African National Curriculum Framework for children from Birth to Four*. Pretoria: Government Printer.

Department of Basic Education (DBE). 2018. *Curriculum Assessment Policy Statement*. Pretoria: Government Printer.

Department of Basic Education (DBE). 2020. *E-Learning Policy*. Pretoria: Government Printer.

Department of Basic Education (DBE). 2021. *ECD Census 2021: Report*. Pretoria: Government Printer.

Díaz de Liaño, G. and Fernández-Götz, M. 2021. Posthumanism, New Humanism, and Beyond. *Cambridge Archaeological Journal* 31(3):543-549.

Díaz-Arévalo, J.M., 2022. In search of the ontology of participation in participatory action research: Orlando Fals-Borda's participatory turn, 1977–1980. *Action Research*, 20(4), :343-362.

Diseko, R. Nyamande, T.T. and Kuhudzai, A.G. 2022. Factors Affecting Teacher Acceptance of Tablets in Their Teaching Practice: A Case Study in the South African Context. *International Journal of Mobile and Blended Learning (IJMBL)* 14(1):1-20.

Dlamini, M.E. 2018. Preparing student teachers for teaching in rural schools using work integrated learning. *The Independent Journal of Teaching and Learning* 13(1):86-96

- Downes, S. 2022. Connectivism. *Asian Journal of Distance Education* 17(1):58-87.
- Du Plessis, E.C. and Letshwene, M.J. 2020. A reflection on identified challenges facing South African teachers. *The Independent Journal of Teaching and Learning* 15(2):69-91.
- Du Preez, P. and Simmonds, S. 2021. Reading posthumanism and decolonisation diffractively towards (re) configuring an ontoepistemic approach to religion education. *British Journal of Religious Education* 43(1):80-90.
- Dube, B. 2020. Rural online learning in the context of COVID 19 in South Africa: Evoking an inclusive education approach. *REMIE: Multidisciplinary Journal of Educational Research* 10(2):135-157.
- Dube, B. Mahlomaholo, S. Setlalentoa, W. and Tarman, B. 2023. Creating Sustainable Learning Environments in the Era of the Posthuman: Towards Borderless Curriculum. *Journal Of Curriculum Studies Research* 5(1): i-x.
- Effinger, E. 2022. Romanticism and Critical Posthumanism. In S. Herbrechter, I. Callus, M. Rossini, M. Grech, M. de Bruin-Molé & C.J. Müller (Eds.), *Palgrave Handbook of Critical Posthumanism* . Cham: Springer International Publishing.
- Fairchild, N. 2019. The micropolitics of posthuman early years leadership assemblages: Exploring more-than-human relationality. *Contemporary Issues in Early Childhood* 20(1), :53-64.
- Fairclough, N. 2013. *Critical discourse analysis: The critical study of language*. New York: Routledge.
- Fairclough, N. 2023. Critical discourse analysis. In M. Handford & J. Gee (Eds.), *The Routledge Handbook of Discourse Analysis* .New York: Routledge.
- Falcon, J., 2023. Toward a critical posthuman geography. *cultural geographies*, 30(1), :19-34.
- Fan, J., Fan, J. and Cheng, Z., 2021, August. Discussion on Teaching Method Reform of Mechanical Principle Course at Private Colleges. In *International Conference on Mechanical Design* . Singapore: Springer Nature Singapore.

Farrelly, M. 2020. Rethinking intertextuality in CDA. *Critical Discourse Studies*, 17(4), :359-376.

Fernández-Götz, M. Gardner, A. de Liaño, G.D. and Harris, O.J. 2021. Posthumanism in archaeology: An introduction. *Cambridge Archaeological Journal* 31(3):455-459.

Ferri, G. 2020. Difference, becoming and rhizomatic subjectivities beyond 'otherness'. A posthuman framework for intercultural communication. *Language and Intercultural Communication* 20(5):408-418.

Flore, J. and Govender, I. 2021. Factors Influencing Secondary School Teachers' Beliefs and Intention to Accept Online Professional Development: An Empirical Study in Mauritius. *Universal Journal of Educational Research* 9(4):880-890.

Forlano, L. 2017. Posthumanism and design. *She Ji: The Journal of Design, Economics, and Innovation* 3(1):16-29.

Förster, M. Maur, A. Weiser, C. and Winkel, K. 2022. Pre-class video watching fosters achievement and knowledge retention in a flipped classroom. *Computers & Education*, 179:104399.

Fourie, L. 2021. Protecting children in the digital society. In J. Grobblaar & C. Jones (Eds.), *Childhood vulnerabilities in South Africa* (pp.229-272). Stellenbosch: African Sun Media.

Fox, N.J. and Alldred, P. 2020. Sustainability, feminist posthumanism and the unusual capacities of (post) humans. *Environmental Sociology* 6(2):121-131.

Galletta, A. and Torre, M.E. 2019. Participatory action research in education. *Oxford Research Encyclopedia of Education*. Available from <https://oxfordre.com/education/education/view/10.1093/acrefore/9780190264093.001.0001/acrefore-9780190264093-e-557> [accessed 27 Jan 2024].

Gambino, A., 2021. *Computers are Sometimes Distinct and Social Actors: Responses to Opinion Conformity from Humans and Computers*. The Pennsylvania State University.

Gare, A. 2021. Against posthumanism: Posthumanism as the world vision of house-slaves. *Borderless Philosophy* 4:1-56.

Garvey, C.M. and Jones, R. 2021. Is there a place for theoretical frameworks in qualitative research? *International Journal of Qualitative Methods* 20:1609406920987959.

Gherardi, S. 2021. A Posthumanist Epistemology of Practice. In C. Neesham (Ed.), *Handbook of Philosophy of Management*. Springer: Cham.

Gladden, M.E., 2018. *Sapient circuits and digitalized flesh: The organization as locus of technological posthumanization*. Defragmenter Media.

Goessling, K.P. 2020. Youth participatory action research, trauma, and the arts: designing youth spaces for equity and healing. *International Journal of Qualitative Studies in Education*, 33(1):12-31.

Govender, R. and Williams, A., THE USE OF COMPUTER TABLETS IN THE TEACHING OF MATHEMATICS . (2023). In Mhakure, D., & Skeleton, D, R (Eds), Proceedings of the 28th Annual National Congress of the Association for Mathematics Education of South Africa, 144-156. Cape Town: AMESA.

Govender, R.G. 2021. Embracing the fourth industrial revolution by developing a more relevant educational spectrum: Coding, robotics, and more. In J. Naidoo (Ed.), *Teaching and learning in the 21st century*. London: Brill.

Gözüm, A.İ.C. and Demir, Ö., 2022. An Investigation of the Relationship between Prospective Teachers' Self-Management and Self-Control Skills, Metacognition and E-Mobile Learning Readiness Perceptions. *Acta Educationis Generalis*, 12(2):163-188.

Graham, M.A. Stols, G.H. and Kapp, R. 2021. Integrating Classroom Technology: South African Mathematics Teachers. *Computers in the Schools* 38(3):189-213.

Grant, C. and Osanloo, A. 2015. Understanding, selecting, and integrating a theoretical framework in dissertation research: Creating the blueprint for your “house”. *Administrative Issues Journal* 4(2):4.

Haleem, A. Javaid, M. Qadri, M.A. and Suman, R. 2022. Understanding the role of digital technologies in education: A review. *Sustainable Operations and Computers* 3:275-285.

Halliday, A.J. Kern, M.L. Garrett, D.K. and Turnbull, D.A. 2019. The student voice in well-being: A case study of participatory action research in positive education. *Educational Action Research* 27(2)73-196.

Hardman, J. and Lilley, W. 2020. Have teachers' perceptions regarding the pedagogical change in grade 6 mathematics lessons with ICTs altered over a 16-year period? A cultural-historical activity theory analysis. *Journal of Educational Research and Reviews*, 8(5):67-80.

Hardman, J. and Lilley, W., 2023. iLearn? Investigating dialogical interaction with tablets in mathematics lessons. *Technology, Pedagogy and Education* 32(3):321-335.

Harris, S., 2020. The Role of Teacher Preparation and Efficacy in Teaching for Deeper Learning and Student Mathematical Understanding in Elementary School: A Comparative Study of the United States and Singapore. <https://hdl.handle.net/11244/324305>

Hasse, C. 2020. *Posthumanist learning: What robots and cyborgs teach us about being ultra-social*. New York: Routledge.

Herselman, M.E. Botha, A. Maremi, K.J. Dlamini, S.B. and Marais, M.A. 2020. Mobile technology affecting teaching and learning in rural schools. <http://hdl.handle.net/10204/11736>

Hlatshwayo, P., 2023. The indelible Verwoerd's edicts: a critical review of their indirect impact on South African basic mathematics education reforms. *African Perspectives of Research in Teaching & Learning (APORTAL)* Vol 7 (2) (2023)

Hooks, A.M. 2020. *Cancel culture: posthuman hauntologies in digital rhetoric and the latent values of virtual community networks*. Unpublished doctoral dissertation. Tennessee: The University of Tennessee.

Jacobs, K., 2021. Discourse analysis. In *Methods in urban analysis*. Singapore: Springer Singapore.

Jeong, S. Sherman, B. and Tippins, D.J. 2021. The Anthropocene as we know it: posthumanism, science education and scientific literacy as a path to sustainability. *Cultural Studies of Science Educatio* 16:805-820.

Johnson, H. and Flynn, C., 2021. Collaboration for improving social work practice: The promise of feminist participatory action research. *Affilia*, 36(3):441-459.

Johnson, J.D., Smail, L., Corey, D. and Jarrah, A.M., 2022. Using Bayesian networks to provide educational implications: mobile learning and ethnomathematics to improve sustainability in mathematics education. *Sustainability*, 14(10):5897.

Jojo, Z. 2019. Mathematics education system in South Africa. In G. Porto (Ed.), *Education systems around the world* . IntechOpen

Jojo, Z.M.M. 2023. Creating an innovative primary school Mathematics teaching environment: The case of Eastern Cape Province. *Journal of Research in Mathematics Education* 12(2):173-191.

Khodabocus, F. Bahadur, G.K. and Armoogum, S. 2022. Innovative Teaching and Learning Methods at the University of Mauritius. In *ICT and Innovation in Teaching Learning Methods in Higher Education* 45: 31-49).

Khosa, C. and Molotsi, A.R. 2020, Teachers' perspectives on the use of smart boards in teaching business studies in the Tshwane West District. In *Proceedings of the South Africa International Conference on Education (SAICEd)* (297-306). Available from

Khoza, S.B. and Biyela, A.T. 2020. Decolonising technological pedagogical content knowledge of first year mathematics students. *Education and Information Technologies*, 25(4):2665-2679.

Kolobe, L. and Mihai, M., 2023. Strategies to support progressed South African Grade 12 Mathematics learners. *Perspectives in Education* 41(4)08-127.

Kolobe, L.V. 2022. *Connectivism as a strategy to support progressed Mathematics learners through Information Communication Technologies*. Unpublished doctoral thesis. Pretoria:University of Pretoria.

Koole, M., 2020. Review of Rosi Braidotti (2019). *Posthuman Knowledge*: Cambridge, UK: Polity Press. 210 . ISBN 9781509535255 (Hardcover).

Kotzé, J., 2022. *Digital transformation of the administrative systems at a major South African university* . Unpublished doctoral thesis. Bloemfontein: University of the Free State).

Larkin, K. and Lowrie, T. 2022. *STEM Education in the Early Years: Thinking About Tomorrow*. Singapore: Springer Nature.

- Lemieux, A. 2021. What does making produce? Posthuman insights into documenting relationalities in maker education for teachers. *Professional Development in Education*, 47(2-3):493-509.
- Lenette, C. 2022. *Participatory action research: Ethics and decolonization*. Oxford: Oxford University Press.
- Lenhoff, C. 2021. *Using the iPad Application IXL and Its Effects on FAST Assessment Scores*. Unpublished Masters dissertation. Iowa: Northwestern College.
- Li, J. Luo, H. Zhao, L. Zhu, M. Ma, L. and Liao, X. 2022. Promoting STEAM education in primary school through cooperative teaching: A design-based research study. *Sustainability*14(16):10333.
- Machmud, M.T., Widiyan, A.P. and Ramadhani, N.R., 2021. The Development and Policies of ICT Supporting Educational Technology in Singapore, Thailand, Indonesia, and Myanmar. *International Journal of Evaluation and Research in Education*, 10(1):78-85.
- Maddux, W.W. Lu, J.G. Affinito, S.J. and Galinsky, A.D. 2021. Multicultural experiences: A systematic review and new theoretical framework. *Academy of Management Annals*, 15(2):345-376.
- Mahlomaholo, M.R. Israel, H. and Mahlomaholo, S.M. 2023. Relationally Enhancing Teacher Education in Early Childhood Learning Environments towards Sustainability. *Journal of Curriculum Studies Research* 5(2):56-68.
- Maibi, M.E.K. 2020. *Developing a strategy to facilitate multigenerational collaboration of teachers to improve their communication skills for teaching*. Unpublished doctoral thesis .Bloemfontein: University of the Free State.
- Maja, M.M. 2023. Teachers' Perceptions of Integrating Technology in Rural Primary Schools to Enhance the Teaching of English First Additional Language. *Journal of Curriculum Studies Research* 5(1):95-112.
- Marongwe, N. and Garidzirai, R. 2021. Together but not together: Challenges of remote learning for students amid the COVID-19 pandemic in rural South African universities. *Research in Social Sciences and Technology* 6(3):213-226.

Masango, M.M. Van Ryneveld, L. and Graham, M.A. 2022. A paperless classroom: importance of training and support in the implementation of electronic textbooks in Gauteng public schools. *The Electronic Journal of eLearnin*, 20(3):336-350.

Mbiza, S., Education cannot be Delayed: Utilization of Mobile Phones in Education in Emergencies. *International Journal of New Technology and Research (IJNTR)* ISSN: 2454-4116, Volume-8, Issue-2, February 2022 Pages 06-10

Mceleli, B.M. 2019. *Enhancing mathematics pedagogical content knowledge in Grade 9 class using problem based learning. Unpublished doctoral thesis.* Bloemfontein: University of the Free State.

McGrath, C., Palmgren, P.J. and Liljedahl, M., 2019. Twelve tips for conducting qualitative research interviews. *Medical teacher* 41(9):1002-1006.

Mellström, U. 2022. Are posthumanism and relational ontologies necessarily emancipatory for masculinity studies? In U. Mellström & B. Pease (Eds.), *Posthumanism and the Man Question: Beyond Anthropocentric Masculinities*. New York: Routledge.

Ministry of Education and Human Resources, Tertiary education and Scientific Research 2015. *National Curriculum Framework - Nine Year Continuous Basic Education, Grades 1 to 6*. The Republic of Mauritius.

Mogashoa, T. 2014. Understanding critical discourse analysis in qualitative research. *International Journal of Humanities Social Sciences and Education* 1(7):104-113.

Mokotjo, L. and Mokhele, M.L. 2021. Challenges of integrating GeoGebra in the teaching of mathematics in South African high schools. *Universal Journal of Educational Research*, 9(5):963-973.

Motala, S. and Stewart, K.D. 2021. Hauntings across the divide: Transdisciplinary activism, dualisms, and the ghosts of racism in engineering and humanities education. *Canadian Journal of Science, Mathematics and Technology Education* 21:1-17.

Msiza, G.M. Malatji, K.S. and Mphahlele, L.K. 2020. Implementation of an e-Learning Project in Tshwane South District: Towards a Paperless Classroom in South African Secondary Schools. *Electronic Journal of e-Learning* 18(4):299-309.

- Mthethwa, L.C. *Integrating social networks in the teaching and learning of mathematics in rural secondary schools*. Unpublished doctoral thesis. Pretoria: University of South Africa
- Mullis, I.V.S. Martin, M.O. Foy, P. Kelly, D.L. and Fishbein, B. 2020. *TIMSS 2019 International Results in Mathematics and Science*. TIMSS & PIRLS International Study Center. Skolporten.se
- Murris, K. 2020. Posthuman child and the diffractive teacher: Decolonizing the nature/culture binary. In A. Cutter-Mackenzie-Knowles, K. Malone & E.B. Hacking (Eds.), 2020. *Research handbook on childhood nature: Assemblages of childhood and nature research*. Cham: Springer.
- Murris, K. and Kohan, W. 2021. Troubling troubled school time: Posthuman multiple temporalities. *International Journal of Qualitative Studies in Education* 34(7):581-597.
- Mwapwele, S.D. Marais, M. Dlamini, S. and Van Biljon, J. 2019. Teachers' ICT adoption in South African rural schools: a study of technology readiness and implications for the South Africa connect broadband policy. *The African Journal of Information and Communication* 24:1-21.
- Myers, C.G., 2021. Performance benefits of reciprocal vicarious learning in teams. *Academy of Management Journal* 64(3):926-947.
- Nabayra, J. 2022. YouTube-based teacher-created videos for online mathematics learning during the pandemic and its effect to students' mathematics performance. *Webology* 19(2):1380-1390.
- Naidoo, J. and Hajaree, S. 2021. Exploring the perceptions of Grade 5 learners about the use of videos and PowerPoint presentations when learning fractions in mathematics. *South African Journal of Childhood Education* 11(1):846.
- Naidoo, J. and Hajaree, S., 2021. Exploring the perceptions of Grade 5 learners about the use of videos and PowerPoint presentations when learning fractions in mathematics. *South African Journal of Childhood Education* 11(1):846.
- Nath, R. and Manna, R. 2023. From posthumanism to ethics of artificial intelligence. *AI & Society* 38(1):185-196.

- Näykki, P. Isohätälä, J. and Järvelä, S. 2021. "You really brought all your feelings out"—Scaffolding students to identify the socio-emotional and socio-cognitive challenges in collaborative learning. *Learning, Culture and Social Interaction* 30:100536.
- Nazari, B. and Niknejad, N. 2021, July. Connectivism: Promising constructs to the e-learning systems success. In *2021 International Congress of Advanced Technology and Engineering (ICOTEN)* :1-6). IEEE.
- Nhlapo, V. 2021. Enhancing the Management Performance of Departmental Heads in Primary and Secondary Schools: PAR as a Practice-Enhancing Process. *Educational Research for Social Change* 10(1):83-101.
- Niccolini, A.D. and Ringrose, J. 2020. *Feminist posthumanism*. London: SAGE Publications.
- Nikolopoulou, K. 2020. Secondary education teachers' perceptions of mobile phone and tablet use in classrooms: benefits, constraints and concerns. *Journal of Computers in Education*, 7(2):257-275.
- Nikolopoulou, K. 2022. Digital technology in early STEM education: Exploring its supportive role. In *STEM, Robotics, Mobile Apps in Early Childhood and Primary Education: Technology to Promote Teaching and Learning*. Singapore: Springer Nature Singapore.
- Ogegbo, A.A. and Aina, A. 2020. Early childhood development teachers' perceptions on the use of technology in teaching young children. *South African Journal of Childhood Education* 10(1):1-10.
- Olivier, J. Oojorah, A. and Udhin, W. 2022. *Perspectives on Teacher Education in the Digital Age*. Cham: Springer.
- Omodan, B.I. 2023. Analysis of connectivism as a tool for posthuman university classrooms. *Journal of Curriculum Studies Research* 5(1):1-12.
- Oojorah, A. and Udhin, W. 2022. Empowering Educators to Use Tablet Technologies Under the Early Digital Learning Programme. In J. Olivier, A. Oojorah & W. Udhin (Eds.), *Perspectives on Teacher Education in the Digital Age*. Singapore: Springer Nature Singapore.

- Oqaibi, H. Basuhail, A. and Abosamra, G. 2021, October. Handprinted Character and Online Signature Recognition Using Residual Convolutional Network: A Comparative Study. In *2021 International Conference on Electrical, Computer, Communications and Mechatronics Engineering (ICECCME)* . IEEE.
- Outhwaite, L.A. Faulder, M. Gulliford, A. and Pitchford, N.J. 2019. Raising early achievement in math with interactive apps: A randomized control trial. *Journal of Educational Psychology* 111(2):284.
- Papadakis, S. Kalogiannakis, M. and Zaranis, N. 2021. Teaching mathematics with mobile devices and the Realistic Mathematical Education (RME) approach in kindergarten. *Advances in Mobile Learning Educational Research* 1(1):5-18.
- Pecina, P. and Marinič, P. 2021. The role of connectivism in technical vocational education and training. In *INTED2021 Proceedings*. IATED.
- Perienen, A. 2020. Frameworks for ICT integration in mathematics education-A teacher's perspective. *Eurasia Journal of Mathematics, Science and Technology Education* 16(6), **p. em1845**.
- Perienen, A., 2020. Frameworks for ICT integration in mathematics education-A teacher's perspective. *Eurasia Journal of Mathematics, Science and Technology Education*, 16(6), **p.em1845**.
- Peters, M.A., 2020. Posthumanism, platform ontologies and the 'wounds of modern subjectivity'. *Educational Philosophy and Theory* 52(6):579-585.
- Qhosola, M. 2023. Early Childhood Education and Care Towards Sustainable Academic Performance in Accounting. *Educational Research for Social Change* 12(1);.31-40.
- Ramsaroop, S. and Petersen, N. 2020. Building professional competencies through a service learning 'gallery walk'in primary school teacher education. *Journal of University Teaching & Learning Practice* 17(4):3.
- Ramulumo, M. and Mohapi, S., 2023. Utilizing Blended Learning to Mitigate the Challenges Brought by Natural Disasters in South African Schools. *Research in Social Sciences and Technology* 8(4):76-93.

- Roberts, N. and Porteus, K., 2023. Two pathways into number work for primary teachers: A counting pathway and a measurement pathway. *African Journal of Research in Mathematics, Science and Technology Education* 27(3):335-349.
- Ross, N. 2021. My Octopus Teacher, Posthumanism, and Posthuman Education: A Pedagogical Conceptualization. *Journal of Curriculum Theorizing* 36(2):1-15.
- Rumjaun, A. Atchia, S. and Reiss, M.J. 2022. Policy responses to the decline in the number of students choosing biology beyond compulsory school level in Mauritius. *Journal of Biological Education* **Volume 57**:1-18.
- Rumjaun, A., Atchia, S. and Reiss, M.J., 2023. Policy responses to the decline in the number of students choosing Biology beyond compulsory school level in Mauritius. *Journal of Biological Education* 57(5):1129-1146.
- Saal, P.E. and Graham, M.A. 2023. Comparing the use of educational technology in mathematics education between South African and German schools. *Sustainability* 15(6), .:4798.
- Saal, P.E. Van Ryneveld, L. and Graham, M.A. 2019. The relationship between using information and communication technology in education and the mathematics achievement of students. repository.up.ac.za
- Şahal, M. and Ozdemir, A.Ş., 2020. Pre-service primary teachers' views and use of technology in mathematics lessons. *Research in Learning Technology*, 28.
- Sarah, A.P.M.A. Amine, B.S.I. and Jinot, B.L. 2023. Students' use of the social media as a learning tool during the COVID-19 pandemic in Mauritius. *The Online Journal of Distance Education and e-Learning*, 11(2).
- Schult, J. Mahler, N. Fauth, B. and Lindner, M.A. 2022. Did students learn less during the COVID-19 pandemic? Reading and mathematics competencies before and after the first pandemic wave. *School Effectiveness and School Improvement* 33(4):544-563.
- Shah, M.T.D.S.K. & Yasir, M.M.A. 2021. Discourse and power relations: a critical discourse analysis of a Pakistani drama. *Pakistan Languages and Humanities Review* 5(2)664-681.

- Shamir, H. Pocklington, D. Yoder, E. Feehan, K. and Ortiz-Wood, C. 2022, May. Long-Term and Early Effects of Computer-Assisted Instruction in Low Socioeconomic Status
- Sherwani, K.A., 2021. Global Review On The Past And Future Of Critical Discourse Analysis/Studies. *Webology (ISSN: 1735-188X)*, 18(1).
- Shumway, J. 2023. *Number sense routines: Building numerical literacy every day in grades K-3*. New York: Routledge.
- Shwin, W. and Lwin, M.O. 2022. Parental mediation of children's digital media use in high digital penetration countries: perspectives from Singapore and Australia. *Asian Journal of Communication* 32(4):309-326.
- Sibanda, S. and Rambuda, A.M. 2021. The implementation of formal assessments in intermediate phase mathematics at primary schools in South Africa. *International Journal of Learning, Teaching and Educational Research* 20(8):300-320.
- Siemens, G., 2006. Connectivism: Learning theory or pastime of the self-amused.
- Simsek, I. and Can, T. 2020. Using tablets for technology integration in classroom differentiation. In F. Altney (Ed.), *The Role of Technology in Education*. IntechOpen.
- Smith, A., 2023. The narrative thread: How narrative comprehension and production are intertwined with early learning indicators - scholar.sun.ac.za
- Smith, R., Mansfield, L. and Wainright, E., 2021. Should I really be here? Problems of trust and ethics in PAR with young people from refugee backgrounds in sport and leisure. *Sport in Society* 25(3):434-452.
- Spinello, E. and Corbett, F. 2020. Connectivism and leadership: harnessing a learning theory for the digital age to redefine leadership in the twenty-first century. *Heliyon*, 6(1).
- Students. In *KES International Conference on Smart Education and E-Learning* . Singapore: Springer Nature Singapore.
- Sungkur, R.K. and Maharaj, M.S. 2021. Design and implementation of a SMART Learning environment for the Upskilling of Cybersecurity professionals in Mauritius. *Education and Information Technologies*.

Susen, S. 2022. Reflections on the (post-) human condition: Towards new forms of engagement with the world? *Social Epistemology* 36(1):63-94.

Szymanski, A. Paganelli, A. and Tassell, J. 2022. 3D Printing in the Mathematics Classroom: Results from a Pilot Study with Advanced Middle School Students. *Journal of Educational Technology Systems* 51(2):169-191.

Tallgauer, M. and Schank, C. 2023. Rethinking Economics Education for Sustainable Development: A Posthumanist Practice Approach. *Sustainability* 15(11):9018.

Tan, O.S. and Chua, J.J.E. 2023. Singapore's Endemic Approach to Education: Re-Envisioning Schools and Learning. In F.M. Reimers (Ed.), *Schools and Society During the COVID-19 Pandemic: How Education Systems Changed and the Road Ahead*. Cham: Springer Nature Switzerland.

Tawil, J. Haddad, C. Farchakh, Y. Sacre, H. Nabout, R. Obeid, S. Salameh, P. and Hallit, S. 2023. Tablet vs. Book learning: Association with memory, attention, and learning abilities among lebanese children. *Vulnerable Children and Youth Studies* 18(3):393-405.

Tay, L.Y. Lee, S.S. and Ramachandran, K. 2021. Implementation of online home-based learning and students' engagement during the COVID-19 pandemic: A case study of Singapore mathematics teachers. *The Asia-Pacific Education Researcher*, 30, pp.299-310.

Teele, T. Nkoane, M. and Mahlomaholo, S. 2020. Erudite pedagogic praxis of extension paradigm for technological skills transfers of the emerging farmers. *South African Journal of Agricultural Extension* 48(2):106-112.

Ten Braak, D. Lenes, R. Purpura, D.J. Schmitt, S.A. and Størksen, I. 2022. Why do early mathematics skills predict later mathematics and reading achievement? The role of executive function. *Journal of Experimental Child Psychology* 214:105306.

Ten Braak, D. Lenes, R. Purpura, D.J. Schmitt, S.A. and Størksen, I. 2022. Why do early mathematics skills predict later mathematics and reading achievement? The role of executive function. *Journal of Experimental Child Psychology* 214:105306.

Teo, T.W. and Choy, B.H., 2021. STEM education in Singapore. *Singapore math and science education innovation: Beyond PISA* (PP. 43-59).Theunissen, K.E. 2021. A

Guide for the use of Tablet PCs for Teaching and Learning Activities for in classroom and distance learning in South African Schools. Unpublished Masters dissertation. Grahamstown: Rhodes University.

Thoma, R. Farassopoulos, N. and Lousta, C. 2023. Teaching STEAM through universal design for learning in early years of primary education: Plugged-in and unplugged activities with emphasis on connectivism learning theory. *Teaching and Teacher Education* 132:104210.

Thurber, A. Collins, L. Greer, M. McKnight, D. and Thompson, D. 2020. Resident experts: The potential of critical participatory action research to inform public housing research and practice. *Action Research* 18(4):414-432.

Toh, S.H. Coenen, P. Howie, E.K. Mukherjee, S. Mackey, D.A. and Straker, L.M. 2019. Mobile touch screen device use and associations with musculoskeletal symptoms and visual health in a nationally representative sample of Singaporean adolescents. *Ergonomics* 62(6):778-793.

TOPAL, H., 2021. Variable selection via the adaptive elastic net: mathematics success of the students in Singapore and Turkey. *Journal of Applied Microeconometrics*, 1(1):41-55.

Torres, K.M. and Giddie, L. 2020. Educator perceptions and use of technology in South African schools. *Peabody Journal of Education* 95(2):117-126.

Triantafillou, C. Psycharis, G. Potari, D. Bakogianni, D. and Spiliotopoulou, V. 2021. Teacher educators' activity aiming to support inquiry through mathematics and science teacher collaboration. *International Journal of Science and Mathematics Education*, 19:, 21-37.

Trochmann, M.B. Viswanath, S. Puello, S. and Larson, S.J. 2022. Resistance or reinforcement? A critical discourse analysis of racism and anti-Blackness in public administration scholarship. *Administrative Theory & Praxis* 44(2):158-177.

Tsakeni, M. 2021. Preservice teachers' use of computational thinking to facilitate inquiry-based practical work in multiple-deprived classrooms. *Eurasia Journal of Mathematics, Science and Technology Education* 17(1): p. em1933.

- Tubtimcharoon, N. 2021. Participatory Action Research: a possible research method for developing Sustainable Tourism in Thailand. *Panyapiwat Journal* 13(2):293-309.
- Valera, L. 2014. Posthumanism: beyond humanism? *Cuadernos de Bioética* 25(3):481-491.
- Van Dijk, T.A. 1998. *Ideology: A multidisciplinary approach*. London: Sage Publications.
- Van Dijk, T.A. 2006. Discourse and manipulation. *Discourse & Society* 17(3):359-383.
- Varpio, L. Paradis, E. Uijtdehaage, S. and Young, M. 2020. The distinctions between theory, theoretical framework, and conceptual framework. *Academic Medicine* 95(7), :989-994.
- Vaughn, L.M. and Jacquez, F. 2020. Participatory research methods—Choice points in the research process. *Journal of Participatory Research Methods* 1(1):13.
- Viberg, O. Andersson, A. and Wiklund, M. 2021. Designing for sustainable mobile learning—re-evaluating the concepts “formal” and “informal”. *Interactive Learning Environments* 29(1):130-141.
- Vicente, S. Sánchez, R. and Verschaffel, L. 2020. Word problem solving approaches in mathematics textbooks: A comparison between Singapore and Spain. *European Journal of Psychology of Education* 35(3):567-587.
- Vitoulis, M., 2022. EDUCATORS'PERSPECTIVES ON THE APPROPRIATENESS OF TECHNOLOGY INTRODUCTION PRACTICES FOR EARLY CHILDHOOD CHILDREN THROUGH THEIR CREATIVE THINKING APPROACH. *European Journal of Alternative Education Studies* 7(2).
- Vygotsky, L.S. and Cole, M., 1978. *Mind in society: Development of higher psychological processes*. Harvard: Harvard University Press.
- Warsah, I. Morganna, R. Uyun, M. Afandi, M. and Hamengkubuwono, H. 2021. The impact of collaborative learning on learners' critical thinking skills. *International Journal of Instruction* 14(2):443-460.

Williams, P.J. and von Mengersen, B. 2022. *Applications of Research in Technology Education: Helping Teachers Develop Research-Informed Practice*. Singapore: Springer Nature Singapore.

Yenidogan, B., 2021. How to Talk About AI Art and Music: An Onto-ethico-epistemological Debate Between Transhumanism and Posthumanism. In *Proceedings of the 2nd Joint Conference on AI Music Creativity* Royal College of Art.

Yeo, J.B., 2021. Use of technology by experienced and competent mathematics teachers in Singapore secondary schools. *Mathematics instructional practices in Singapore secondary schools*.303-316. Springer link

Yu, H., 2021. Critical Thinking Formation in the Scope of Connectivism. *International Journal of Linguistics Studies*1(2):60-65.

Zhai, X. and Pellegrino, J.W., 2023. Large-scale assessment in science education. In *Handbook of research on science education*. Cambridge: Routledge.

Ziegler, T.D. 2021. The Anti-Enlightenment Tradition as a Common Framework of Fascism and the Contemporary Far Right. *Fascism* 10(1):16-51.

Zulu, N., Harvey, J. and Reddy, V., State of readiness for digitisation of Science Olympiads and competitions in South Africa. Saasta.ac.za

APPENDICES

APPENDIX 1: ETHICAL CLEARANCE FOR UNIVERSITY OF MPUMALANGA

 **UNIVERSITY OF
MPUMALANGA**
Creating Opportunities

Prof Mahlomaholo Geoffrey MAHLOMAHOLO

Dear Thabethe MG
220068984

Protocol Reference Number: UMP/Thabethe220068984/SECE /Med/2023
Project Enhancing the learning of grade 1 mathematics using tablets at a school in Mkhondo.

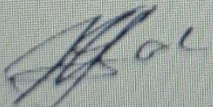
Approval Notification
FULL APPROVAL

Any alteration/s to the approved research protocol i.e. Questionnaire/Interviews Schedule, Informed Consent form, Title of the project, Location of the study, Research Approach and methods must be reviewed and approved through the amendment/ modification prior to its implementation. In case you have further queries, please quote the above reference number.

PLEASE NOTE: Research data should be stored securely in the School/ division for a period of 5 years. The Ethical Clearance certificate is only valid for a period of 3 years from date of issue. Thereafter, Recertification must be applied for on an annual basis.

Wishing you the best with your study.

Yours faithfully,



Prof MG Mahlomaholo
Name of Chairperson (Chair FREC)
Cc: Research Office Administrator, Mr N Kashe and Ms. T Mlambo
Research Committee Chair, Prof H. H. H. H.

APPENDIX 2: PERMISSION LETTER FROM THE CIRCUIT



education
DEPARTMENT: EDUCATION
MPUMALANGA PROVINCE

Amsterdam Circuit Office
P.O Box, Amsterdam, 2375
2ND Environmental Centre
Vincent Street, Amsterdam
Telephone number : 073 689 6516
Email : nomvulagsibiya@gmail.com

Litiko leTefundvo Umyango we Fundo Departement van Onderwys Ndzawulo ya Dyond

26 APRIL 2023

Dear Sir / Madam

**Re-Request for permission to conduct research at a school at KwaThandeka
Circuit in Mkhondo**

I Nomvula G Sibiya hereby authorise **Mrs Gugu Memory Thabethe** with student no: **220068984** to conduct her research at **Nokuthula Primary School** from April 2023

I declare and understand the aim, scope and purpose of her study as the topic focus on: Enhancing learning of grade 1 Mathematics using tablets. I believe that her study will produce positive result to the school and to the circuit at large as we move with STEM education worldwide.

I hope you will find everything in order

Yours Faithfully

Mrs Nomvula G Sibiya [Circuit Manager]



APPENDIX 3: PERMISSION FROM A PARENT

Support Teams. If you experience distress during the process, the involvement of social workers or psychologist will be of good help.

C. CONFIDENTIALITY

Each learner will be treated as an individual within the group. All data generated during the study will be kept safe and will be communicated with care and diligent to study group and kept safe in the lockable files and storage.

D. BENEFITS OF PARTICIPANTS

Your child will receive no direct benefit from participating in this study; however, your child will remain the beneficiary of the study by making possible for the improvement of the lives and education of the marginalised group.

E. VOLUNTARY PARTICIPATION

Your decision to allow your child to participate in this study is voluntary and will not the relationship of being the learner at the school. If you choose to withdraw your child from this study, you can withdraw your consent and discontinue your child participating at any time prejudice.

F. TIME FRAME

The research study is intended to start from 01/09/2023 until 30/11/2023

CONSENT



I, Nomasonto Zulu give my consent for my child Asiphe
Zulu to participate

in the study. I have read all the information and I understand the contents and nature of the study.

APPENDIX 4: PERMISSION FROM A CORESEARCHER

Your decision whether or not to participate in this study is voluntary and will not affect your relationship with all partners and organisation involved. If you choose to withdraw from this study, you can withdraw your consent and discontinue participating at any time prejudice.

G. TIME FRAM

The research study is intended to start from 01/09/2023 until 30/11/2023

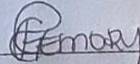
CONSENT

☒ I MATHOSMUCLO Gule give my consent to participate in the study. I have read all the information and I understand the contents and nature of the study. My participation in the study is voluntary, therefore, I have the right to withdraw my participation at any stage. understanding to the fullest of my knowledge

☐ I _____ refuse to give my consent to participate in the study.


Signature of research participant

19/04/23
DATE

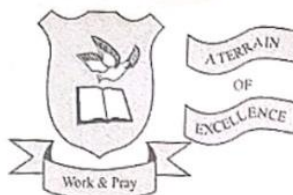

Signature of researcher

19 April 2023
DATE

APPENDIX 5: LETTER OF PERMISSION FROM THE SCHOOL

NOKUTHULA PRIMARY SCHOOL

CELL: 073 188 9880 / 082 530 6571
Email: jeremiabguliwe@gmail.com
Gert Sibande District
Amsterdam Circuit
Emis No: 800017194



P.O Box 964
Piet Retief
2380

21 April 2023

Dear Sir/Madam

LETTER OF CONSENT

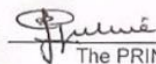
Nokuthula Primary School as Voluntary Participation in the research Project entitled; Enhancing learning of Grade 1 Mathematics using tablets at Nokuthula Primary School in Mkhondo Gert Sibande District. The study will entails working together with teachers, HOD, principal, learners and parents.

I Jeremia Bonginkosi Guliwe, the principal of Nokuthula Primary School, hereby voluntarily and willingly agreed to allow my school staff, learners and parents to participate in the abovementioned study introduced and explained to me by MRS GUGU MEMORY THABETHE currently a student enrolled for Master's degree at University of Mpumalanga

I further declare that I understand as was explained to me by the Researcher. The aim, scope and possible consequences and benefits and methods of penetrating date proposed by the researcher as well as the means by which the researcher will attempt to ensure the confidentiality and integrity of the information.

Your faithfully

MR J B GULIWE


The PRINCIPAL



APPENDIX 6: LETTER FROM LANGUAGE EDITOR



EDITING SERVICES

☎ 072 377 5585

✉ carmen@ufs.ac.za

CERTIFICATE OF LANGUAGE EDITING

This certifies that I have edited the work detailed below below for language.

Title:

"ENHANCING LEARNING OF GRADE 1 MATHEMATICS USING TABLETS AT A
SCHOOL IN MKHONDO"

by

GUGU MEMORY THABETHE

Student number 220068984

Regards

A handwritten signature in blue ink, appearing to read "Carmen Nel".

Carmen Nel

28 January 2024

Professional editing of articles, thesis, dissertations and books

APPENDIX 7: PLAGIARISM (TURN IT IN) REPORT

ENHANCING LEARNING OF GRADE 1 MATHEMATICS USING TABLETS AT A SCHOOL IN MKHONDO

ORIGINALITY REPORT

2%	2%	1%	0%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	scholar.ufs.ac.za Internet Source	1%
2	ukzn-dspace.ukzn.ac.za Internet Source	<1%
3	wikizero.com Internet Source	<1%
4	Pharmacy Practice Research Methods, 2015. Publication	<1%
5	Submitted to University of KwaZulu-Natal Student Paper	<1%
6	T Teele, M Nkoane, S. Mahlomaholo. "Erudite pedagogic praxis of extension paradigm for technological skills transfer of the emerging farmers", South African Journal of Agricultural Extension (SAJAE), 2020 Publication	<1%
7	vital.seals.ac.za:8080 Internet Source	<1%

8	Submitted to Laureate Higher Education Group Student Paper	<1 %
9	5dok.net Internet Source	<1 %
10	Submitted to Mancosa Student Paper	<1 %
11	Submitted to University of South Africa Student Paper	<1 %
12	uir.unisa.ac.za Internet Source	<1 %
13	Submitted to North West University Student Paper	<1 %
14	repo.undiksha.ac.id Internet Source	<1 %
15	Gates, Alyssa Kupsco. "Middle School Educators' Perceptions of Professional Development for Virtual Education during COVID-19", Concordia University Chicago Publication	<1 %
16	researchspace.ukzn.ac.za Internet Source	<1 %
17	Archana Shrivastava. "Using connectivism theory and technology for knowledge	<1 %

creation in cross-cultural communication",
Research in Learning Technology, 2018

Publication

18	Bernhard Resch, Chris Steyaert. "Peer Collaboration as a Relational Practice: Theorizing Affective Oscillation in Radical Democratic Organizing", Journal of Business Ethics, 2020 Publication	<1 %
19	vdocument.in Internet Source	<1 %
20	www.researchgate.net Internet Source	<1 %
21	Jon Altuna, Arkaitz Lareki. "Analysis of the Use of Digital Technologies in Schools That Implement Different Learning Theories", Journal of Educational Computing Research, 2015 Publication	<1 %
22	slidetodoc.com Internet Source	<1 %
23	docplayer.net Internet Source	<1 %
24	ia801400.us.archive.org Internet Source	<1 %

25	Barnett, Denzil O.. "Social Media and the Learning and Engagement Experiences of Minority Doctoral Students", Walden University, 2023 Publication	<1 %
26	etheses.uin-malang.ac.id Internet Source	<1 %
27	www.emeraldinsight.com Internet Source	<1 %
28	www.southernearlychildhood.org Internet Source	<1 %
29	A Mutiarawati, S Nurhayati, A Marini, M S Sumantri. "Learning mathematics through media scales of lamps from used goods", Journal of Physics: Conference Series, 2021 Publication	<1 %
30	dspace.nwu.ac.za Internet Source	<1 %
31	elibrary.tucl.edu.np Internet Source	<1 %
32	gua.soutron.net Internet Source	<1 %
33	www.wits.ac.za Internet Source	<1 %

34 Anna Kamakari, Athanasios Drigas. "Advanced E-Learning Services for Teachers", International Journal of Knowledge Society Research, 2012 <1 %
Publication

35 Saka, Tionge Weddington. "An Exploration of Mathematics Classroom Culture in Selected Early Grade Mathematics Classrooms in Malawi", University of Johannesburg (South Africa), 2021 <1 %
Publication

36 lisahunter, Elke Emerald, Gregory Martin. "Participatory Activist Research in the Globalised World", Springer Science and Business Media LLC, 2013 <1 %
Publication

Exclude quotes On
Exclude bibliography On

Exclude matches < 5 words