

**EXPLORING THE USE OF MANIPULATIVES IN GRADE 1
MATHEMATICS CLASSROOMS LOCATED IN THE
MOTHEO DISTRICT**

by

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Dr. B. Ndlovu (Supervisor)

DECLARATION

I, Mmaphadi Motholo declare that the dissertation, Exploring the Use of Manipulatives in Grade 1 Mathematics classrooms located in the Motheo District, submitted for the qualification of Master of Early Childhood Care and Education at the University of the Free State is my own independent work.

All the references that I have used have been indicated and acknowledged by means of complete references.

I further declare that this work has not been previously submitted by me at another university of faculty for the purpose of obtaining a qualification.



SIGNED

16/01/2024

DATE

ABSTRACT

Manipulatives in the field of Early Childhood Education has been the subject of extensive debate and disagreement throughout its lengthy history. However, the South African Department of Education has acknowledged the significance of including three-dimensional resources in the instruction of Mathematics for younger learners. Despite this recognition, the current academic achievement in Mathematics within the country is still unsatisfactory. Therefore, this study sought to explore how Manipulatives are used in Grade 1 Mathematics classrooms to provide further insight into why learners lack a solid Mathematical foundation.

As a theoretical stance, Vygotsky's Sociocultural Theory was applied, and a qualitative research methodology incorporating a case study design was used. Since a case study design was used, the investigation was confined to two schools in the Motheo District of Free State, Bloemfontein. To create the qualitative data for the study, two different approaches were combined. Semi-structured interviews were first used, and then observations were made. Five Grade 1 teachers made up the sample of participants.

Even though teachers in Grade 1 use Manipulatives to teach Mathematics, the study's findings indicate that a few issues persist that hinder teachers' ability to effectively employ these tools to the advantage of their learners. Some of the challenges identified are time constraints, overcrowding in classrooms, lack of resources, and teachers' misunderstanding of how to use Manipulatives to improve learning rather than them serving as a distraction.

The Department of Education needs to convince universities to offer Foundation Phase teachers ongoing training in play-based Manipulatives learning, and to give them access to resources that will expand their understanding of Manipulatives Mathematics instruction. Teachers in Grade 1 should also become more knowledgeable about creative methods to make and use Manipulatives as part of their curriculum.

The study concluded that in-service teachers require ongoing training on the successful use of Manipulatives to help young learners gain a more holistic knowledge of Mathematics.

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DEDICATION

This work is dedicated to my aunt and grandparents, who I lost within the span of four years. They planted the idea in my head, perhaps unwittingly, that I can succeed academically and should never give up.

Rakgadi Mamotlatsi, Ntatemoholo Silas, Ntatemoholo Jacobo, Ntatemoholo Dube, and Ntatemoholo Ntsoakele, this one is for you.

RESEARCH JOURNEY

It took me two years to write this study. The process of selecting a topic was not difficult, as it was driven by my genuine passion for teaching young learners and my desire to go deeper into the realm of instructional strategies in Mathematics education.

I wrote my proposal, successfully defended it, and assumed the rest of my studies would proceed without challenges, but I was mistaken.

My understanding of teaching and learning in the field of Mathematics significantly increased as a result of Chapter 2. Furthermore, all the participants were willing and went above and beyond to contribute to my study, making data collection relatively straightforward.

When it came time to finalise the final chapters, I fell sick and lost around two months of writing. My emotional well-being was affected, and I lost hope that I would complete my studies. On the eve of my aunt's death, she imparted to me words of encouragement, urging me to persevere and be steadfast in my academic pursuits. This last profound interaction with her served as an encouragement, reigniting my motivation, and prompting me to resume my research and pick up my laptop again.

I finished my last three chapters in less than two months, which gave me confidence that I can accomplish anything I set my mind to. Eventually, I hope to take what I have learned here and apply it in the classroom.

LIST OF ACRONYMS

Acronym	Definition
3-D	Three Dimensional
ANA	Annual National Assessment
CAPS	Curriculum and Assessment Policy Statement
DBE	Department of Basic Education
SA	South Africa
SSE	Systemic School Evaluation
TIMMS	Trends in International Mathematics Science Study
UNICEF	United Nations Childrens Fund

LIST OF TABLES

Table	Page
Table 1: Data analysis summary	16
Table 2: Resources for Mathematics teaching	31
Table 3: Formal and informal Manipulatives	35
Table 4: Participant profiles	61
Table 5: Data generation plan	62
Table 6: Participant demographics	73
Table 7: Summary of findings and implications	119

LIST OF FIGURES

Figure	Page
Figure 1: Zone of Proximal Development	50
Figure 2: Map of research site, Bloemfontein	58
Figure 3: Themes	69
Figure 4: Lesson on grouping and sharing in RP. 2 Spiki-Evelyn classroom	78
Figure 5: Informal Manipulatives: Apples and pears in R.P 4 Pentse-Reed's classroom	86
Figure 6: Example of formal Manipulatives six bricks	87
Figure 7: Abacus	88
Figure 8: R.P 4 Pentse-Lesedi lesson using Unifix cubes	93
Figure 9: R.P 4 Pentse-Reed lesson using number boards and ice-cream sticks	96

TABLE OF CONTENTS

Declaration	i
ABSTRACT	ii
ACKNOWLEDGEMENTS.....	iv
DEDICATION	v
RESEARCH JOURNEY	vi
LIST OF ACRONYMS	vii
LIST OF TABLES	viii
LIST OF FIGURES.....	ix
TABLE OF CONTENTS	x
CHAPTER 1: RESEARCH PROPOSAL.....	1
1.1 Introduction.....	1
1.2 Background	2
1.3 Problem Statement.....	4
1.4 Rationale for the study.....	5
1.5 Aim of the study.....	5
1.5.1 Main research question.....	6
1.5.2 Sub research questions.....	6
1.6 Delimitation of the study	6
1.7 Significance of the study.....	7
1.8 Definition of operational concepts	7
1.9 Preliminary literature review	8
1.9.1 Views on the use of Manipulatives in the classroom.....	8
1.9.2 Effective Manipulatives use in the classroom.....	10
1.9.3 Summary of preliminary literature review.....	12

1.10 Theoretical framework.....	12
1.11 Methodology.....	13
1.11.1 Research paradigm.....	14
1.11.2 Research approach.....	14
1.11.3 Research design.....	14
1.12 Instruments for data collection.....	15
1.13 Study site.....	15
1.13.1 Participants selection.....	15
1.14 Data analysis.....	16
1.15 Ethical considerations.....	17
1.15.1 Dependability.....	17
1.15.2 Confirmability.....	17
1.15.3 Transferability.....	17
1.15.4 Comfortability.....	18
1.16 Summary of CHAPTER 1.....	18
1.17 Organisation of chapters.....	19
CHAPTER 2 LITERATURE REVIEW AND THEORETICAL FRAMEWORK..	20
2.1 Introduction.....	20
2.2 Background/perspectives on Manipulatives.....	20
2.2.1 International background.....	22
2.2.2 African Background.....	24
1.2.3 South African Background.....	26
2.3 Defining Manipulatives.....	27
2.4 Types of Mathematics Manipulatives.....	30
2.5 Rationale for using Manipulatives.....	35
2.6 Effective teaching using Mathematics Manipulatives.....	38

2.6.1 Concrete, Representational, Abstract Model (CRA).....	38
2.6.2 Choose appropriate Manipulatives - the simpler the better	40
2.6.3 Social Constructivism.....	41
2.6.4 Create a stimulating, collaborative environment.....	43
2.7 Teacher’s knowledge and beliefs on Manipulatives use	44
2.8 Challenges teachers face.....	45
2.9 Theoretical Framework.....	47
2.9.1 Introduction	47
2.9.2 Social interaction.....	48
2.9.3 Zone of Proximal Development and Scaffolding	49
2.10 Conclusion.....	51
CHAPTER 3: RESEARCH DESIGN AND METHODOLOGY.....	53
3.1 Introduction.....	53
3.2 Research approach.....	53
3.3 Research paradigm.....	54
3.4 Design of the study.....	55
3.5 Research sampling.....	56
3.6 Study site.....	57
3.7 Population.....	60
3.8 Data generation process.....	61
3.9 Instruments for Data Collection.....	62
3.10 Measures of instruments’ validity and reliability and piloting.....	65
3.11 Data collection procedures.....	66
3.12 Data analysis procedures.....	67
3.13	Ethical
considerations.....	669
3.13.1 Participants’ rights, informed consent, confidentiality	70

3.14 Conclusion.....	70
CHAPTER 4: FINDINGS AND DISCUSSION	72
4.1 Introduction.....	72
4.1.1 Biographical characteristics of participants.....	73
4.2 Theme 1: Defining Manipulatives	73
4.2.1 3D Concrete objects.....	74
4.3 Theme 2: Exploring teachers' perspectives on Manipulatives in the classroom	75
4.3.1 Deeper conceptual understanding.....	76
4.3.2 Integrating Mathematics topics.....	78
4.3.3 Intervention tools.....	80
4.4 Theme 3: Types of Manipulatives.....	84
4.4.1 Informal Manipulatives.....	84
4.4.2 Formal Manipulatives.....	86
4.5 Theme 4: Role of the teacher during mathematics lesson using manipulatives	88
4.5.1 Effective approaches for introducing Manipulatives in Grade 1.....	89
4.5.2 Scaffolding.....	94
4.5.3 Social interaction.....	99
4.6 Theme 5: "Navigating the hurdles: Teacher challenges in implementing Manipulatives".....	102
4.6.1 Overcrowding.....	103
4.6.2 Lack of resources.....	105
4.6.3 Time.....	106
4.7 Conclusion.....	110
CHAPTER 5: CONCLUSIONS AND IMPLICATIONS.....	111
5.1 Introduction.....	111

5.2 Reflections on theoretical framework	111
5.3 Major findings from the research	113
5.4 Limitations	118
5.5 Contribution to research	118
5.6 Recommendations for future research	119
5.7 Summary	119
References	121
Appendices.....	137
Appendix A: Ethical Clearance	137
Appendix B: gatekeeper’s letter.....	138
Appendix c: Principal’s letter	139
.....	141
.....	141
Appendix D: Participants consent letter.....	142
Appendix E: Semi-Structured Interview.....	144
.....	145
Appendix f: Observation Tool	146
Appendix G: Editing certificate	148
Appendix H: Turnitin report.....	149

CHAPTER 1: RESEARCH PROPOSAL

1.1 INTRODUCTION

This research proposal was designed to explore the use of Manipulatives in grade 1 Mathematics classrooms. Manipulatives are physical objects or materials that are used to support learning and understanding in various subject areas, particularly in Mathematics and science (Rowly, 2020:3). These hands-on tools are designed to engage learners and help them explore and manipulate concepts in a concrete and tangible way.

According to Gecu-Parmaksiz and Delialioğlu, (2019), Manipulatives can include items such as blocks, counters, shapes, measuring tools, and interactive digital resources. They provide a multisensory experience that enhances comprehension and problem-solving skills (Gecu-Parmaksiz and Deliagioglu, 2019). By incorporating Manipulatives into lessons, teachers can cater to different learning styles and encourage active participation (Liggett and Scott, 2017). For example, using blocks to represent numbers can help learners visualize Mathematical operations and grasp abstract concepts more easily (Peltier, Morin, Bouck, Lingo, Pulos, Scheffler, Suk, Matthews, Sinclair and Deardoff, 2019).

Furthermore, Manipulatives also promote critical thinking and problem-solving skills by allowing learners to experiment and test their hypotheses (Rowly, 2020). Overall, these hands-on tools play a crucial role in fostering a deeper understanding of complex subjects and promoting meaningful learning experiences.

In South Africa, Manipulatives in Mathematics education have gained recognition and importance especially through the Curriculum Assessment Policy Statement (CAPS) (CAPS, 2013). Teachers have recognized the value of hands-on learning experiences and the impact they have on students' understanding and retention of Mathematical concepts (Maboya, Jita and Chimbi, 2020). By incorporating Manipulatives into their instruction, teachers create a more engaging and

interactive learning environment, catering to the diverse needs of their students and promoting a deeper understanding of Mathematics concepts (Mntunjani, Adendorff and Siyepu, 2018).

In line with published studies, the researchers' experiences as an in-service Foundation Phase teacher have also demonstrated that, giving learners tangible objects to compare and work with, like pattern blocks and cubes, helps them develop a grounded understanding of Mathematical concepts. Additionally, working with learners and attending professional development workshops led by specialists on the appropriate techniques for teaching Mathematics concepts to young learners, further supports that there is a recognised value in using Manipulatives in the South African Mathematics landscape.

However, despite everything the researcher read and experienced on the advantages of actual Manipulatives, learner performance has hardly been above the passing level in South Africa as evidenced by the Trends in International Mathematics and Science Study (TIMSS) in 2019. Thus, the researcher was prompted to explore why learners still seem to find it difficult to independently solve problems, given that multiple studies have shown that Manipulatives are an excellent tool for helping them develop Mathematical proficiency. For this study, the types of Manipulatives which were under investigation are concrete ones.

The researcher entered grade 1 Mathematics classrooms and observed and interviewed teachers to gain greater insight into whether they used Manipulatives and if so, their abilities to implement them meaningfully to help play a vital role in learners' understanding of Mathematics.

1.2 BACKGROUND

Over the past few years, there has been significant research conducted to find solid explanations for the subpar performance of Mathematics in our schools (Trouche, Guedet, Pepin, 2019; Mlachila and Moeletsi, 2019). A study carried out by Chand, Chaudery, Prasad (2021), suggests that many primary schools are

devoid of teachers that carry the potential and ability to birth Mathematical knowledge to learners, creating a lack of interest in students and further translating into poor achievement.

Similarly, Mabena, Mokgosi & Rampela (2021) explain that teachers in the Foundation Phase often utilise teaching methods that are difficult for learners to understand and that the lack of concrete aids being adopted in the classroom, laid a ground for learners being unable to follow abstract concepts. Additionally, very recently the Minister of Education, Angie Motshekga, lamented that the average scores in Mathematics reveal that there is an urgency to tackle Foundational Literacy and Numeracy (Magubane, 2022).

An example of mediocre results in Mathematics can be found in the last Annual National Assessment (ANA); which was formally introduced in 2011 to monitor Education Performance and Learner Achievement. It targets specifically Literacy and Numeracy as they are universally regarded as key areas to strengthening learner development (Van der Berg, 2015).

During the last ANA results of 2014, The National Department of Education (DBE) tabulated many of its findings by dividing them into three levels: a) National b) Provincial c) District. In the Motheo District, in the Free State Province, Foundation Phase Mathematics averaged 56% (Department of Education, 2014:92). Though the DBE considers a percentage of 50-59% as an adequate achievement, it brings into question whether the percentage will keep declining because according to Dolin (2022), as learners progress through the grades, Mathematical concepts become complex.

FS					
	FEZILE DABI	54.9	61.4	53.8	59.5
	LEJWELEPUTSWA	56.4	59.5	54.7	59.2
	MOTHEO	55.2	56	52.8	55.7
	THABO MOFUTSANYANA	54.8	59.8	57.6	63.1
	XHARIEP	48.4	50.9	47.7	49.3

Source: Department of Education (2014:92)

The above statistics closely matched the Foundation Phase results of two former primary schools the researcher worked at. They questioned why averages in foundation phase Mathematics classrooms were not excellent (80%-90%); when research that has been carried over the years has consistently proven that one of the ways to a successful transfer of Mathematical knowledge, is with Manipulatives (Ligett, 2017). The researcher notes that there are many other contextual factors that impact learner performance however, the focus of this study was to assess whether the lack of concrete object use in the classroom was one of them.

To further elaborate on the above, as a Grade 2 and 3 teacher, the researcher observed that although they were implementing Manipulatives, especially when introducing new concepts, they had a problem of learners relying on them too often and lacking the ability to solve problems independently. The researcher pondered on whether this was due to how they were using the Manipulatives or if learners were simply not used to having concrete experiences from their younger years.

Considering the above, the researcher focused on exploring the use of concrete materials in Grade 1 Mathematics Classrooms as they were of the belief that Grade 1 is an extremely crucial year. Should a learner find enjoyment in their first experiences of Mathematics, they will learn more easily, become confident in their abilities, and ultimately build a solid Mathematical foundation to carry them through the rest of their lives. They did this through classroom observations and semi-structured interviews.

1.3 PROBLEM STATEMENT

Based on the results of the Foundation Phase Systemic Evaluation (SSE) Report, it was discovered that only 56.6% of Grade 3 learners in 2019 were able to achieve the minimum passing score of 50% (Department of Education, 2019:6). Furthermore, the latest TIMMS results revealed that South Africa continues to be ranked as one of the lowest performing countries (TIMMS, 2019). Therefore, it is

imperative to confront and seek understanding for why South African Foundation Phase learners continue perform poorly in Mathematics.

1.4 RATIONALE FOR THE STUDY

According to research by Back (2022), Mathematics achievement for learners improves dramatically when teachers apply Manipulatives, or other forms of hands-on materials. Although teachers have embraced the use of Manipulatives in their classrooms, Steyn and Adendorff (2020:25) argue that they are not always used effectively. For instance, it is not uncommon for teachers to use a Manipulative just once when introducing a new concept, and then never again.

Furthermore, although there is a wealth of literature about incorporating Manipulatives into the classroom setting, the researcher found that very little of it focuses on the Grade 1 classroom, which serves as the stepping stone into Mathematics as a subject in South Africa. Additionally, teachers in low-income communities may face contextual issues that prevent the efficient use of Manipulatives, and these have received little attention in the literature.

Moreover, as the Systemic Evaluation Report (2019) demonstrates, it is important to research and identify potential causes for the poor Mathematics performance in Foundation Phase classrooms in South Africa. Considering the contextual difficulties that teachers confront, we need to find additional solutions that can help learners in South African schools have access to the amazing world of Manipulatives.

1.5 AIM OF THE STUDY

To explore the use of Manipulatives in Grade 1 Mathematics classes located in the Motheo District.

- Explore the kind of Manipulatives used by Grade 1 teachers in the classroom to teach Mathematics.
- Identify how teachers use Manipulatives to teach Grade 1 Mathematics.

- Define possible challenges faced by teachers when using Manipulatives to teach Mathematics.

1.5.1 Main research question

How are Manipulatives being utilised in the Grade 1 classroom to teach Mathematics?

1.5.2 Sub research questions

1. What kind of Manipulatives are teachers using when teaching Mathematics?
2. How do grade 1 teachers teach Mathematics with Manipulatives?
3. What challenges are teachers facing when teaching using Manipulatives?

1.6 DELIMITATION OF THE STUDY

Theofanidis and Fountouki (2018:157) define delimitation as statements that show what the researcher does not want to include through the process of the study. Therefore, the centre of this research was not to compare different teachers' abilities to use Manipulatives. Neither was the focus on distinguishing the Grade 1 teacher with the finest teaching practice.

Furthermore, the study was also not conducted to establish the best methods to use when working with Manipulatives but instead, the aim was to understand whether Manipulatives were being implemented by Grade 1 teachers and in case they were, how regularly and productively were they being implemented. This brought about an understanding of how teaching practices may be contributing to low learner performance in the Foundation Phase. Lastly, the study was concentrated within the Motheo District. Two schools from different contexts framed the study. The schools in the sample were in close proximity to each other to mitigate transportation challenges, for example, petrol costs.

1.7 SIGNIFICANCE OF THE STUDY

South Africa has performed poorly in international Mathematics and science assessments year after year, according to the 2019 Trends in International Mathematics and Science Study (TIMSS). As a result, it ranks among the lowest amongst developing nations (Department of Education, 2020). Therefore, further field study on South African learners' Mathematical competence is urgently needed especially considering the amount of teaching time that has been lost due to the COVID19 pandemic.

The results of this study will further help teachers and other pertinent parties recognise the value of Manipulatives and learn effective strategies on how to use them. It considered how Manipulatives undermine teachers' efforts and cause learners to continue making slow progress. For example, Maboya, Jita and Chimbi (2020) explain that simply using Manipulatives does not mean that learners will automatically grasp a concept. In fact, inefficient teaching strategies can result in negative outcomes such as learners depending on them too often or becoming too distracted by their features.

The ultimate goal was to educate stakeholders on how to better assist teachers and furnish all schools with enough materials. This, in turn, will encourage a slew of fresh academic eyes to dive headfirst into this research topic.

1.8 DEFINITION OF OPERATIONAL CONCEPTS

1. Annual National Assessment: Standardised National assessments for Mathematics and Languages.
2. Curriculum Assessment Policy Statement: Clear Policy document highlighting all Learning areas and offering guidelines for teaching and assessments in all subjects from Grade R-12.
3. Department of Basic Education: A department in the South African Government that oversees primary and secondary education.
4. Early Childhood Development: Guidelines on programmes and policies aimed at learners from birth to nine years old.
5. Foundation Phase: The initial phase of formal schooling in South Africa.

6. Manipulatives: Objects that can be moved and touched by learners when working with Mathematical concepts.
7. Motheo District: One of five Districts in the Free State Province.
8. Outcome Based Education: Education that articulates ideas of the skills and knowledge students should have when they exit the schooling system.

1.9 PRELIMINARY LITERATURE REVIEW

One of the key teaching strategies in Early Childhood is the employment of Manipulatives within the classroom. Evidence proposes that the success of learners in Mathematics partially relies on them being able to see, feel, control and touch objects (Charles, 2020). Therefore, this literature review explored various research on how Manipulatives within the classroom emphatically cater to learners, as well as looking at contrasting debates around this belief. It focused on the various views related to Manipulatives within Mathematics instruction, as well as how they should be implemented to guarantee successful learning.

1.9.1 Views on the use of Manipulatives in the classroom

Early Childhood Professionals and numerous Formative Clinicians are of the view that learners require play and investigation to memorise. One such strategy of play and exploration within the classroom is through Manipulatives. Different theories exist with respect to what “Manipulatives” mean. Steyn and Adendorff (2020) characterise Manipulatives as objects that can be moved and touched for the purpose of improving scientific understanding for learners. A case of such objects can be base ten blocks, flash cards and counters.

Additionally, Moyer (2001:176) sees Manipulatives as materials that can be implemented to clarify numerical concepts that are non-pictorial. In this way, it is critical for Manipulatives to be objects that can be seen and touched so that learners are given an opportunity to control them. Quigly (2021) echoed the same opinion and communicated that Manipulatives are objects which learners can

handle in a tangible way, permitting them to think consciously and subconsciously about the topic. This is synonymous with Nicholas-Noir and Dias (2023) who notes that, teaching Mathematical concepts can be done through the manipulation of objects.

This is important for South African education because Manipulatives not only help with experiential learning that improves understanding, but they also help level the playing field in a diverse educational environment where schools have different access to resources. This is because Manipulatives give students concrete tools that help them conceptualise abstract ideas.

Seminal researchers such as Piaget (1936) and Vygotsky (1978) have released broad studies into how learners learn. The common ideology is that pupils must manipulate objects (learn through play) for them to understand the processes involved in finding an answer. Additionally, Kuennen and Beam, (2020) have written that since teaching and learning is a challenging task, it is critical for teachers to understand the Mathematical concepts they are teaching and select fitting Manipulatives to present the content in an effective and efficient manner.

This study is crucial because, whereas some educators may be adept at using Manipulatives in the classroom, others could need professional development or training to make the most of them. Teachers should possess the knowledge and skills to proficiently utilise Manipulatives and effectively incorporate them into the curriculum.

Moreover, during the researchers' teaching career, they have experienced that the use of Manipulatives suits different learning styles that can be found within the classroom, develops essential skills that can be used in other learning areas and provides learners with a sensory experience (Mabenam Mokgosi and Ramapela, 2021). Furthermore, it clears the way for a smooth transition between concrete and abstract thinking. Hence, it is reasonable to declare that Manipulatives are important in the classroom.

Meanwhile, a professional body in the United States called the National Council of Teachers of Mathematics (NCTM), advances the implementation of different representations in the classroom eg. Manipulatives, graphical and pictorial. the organisation states that it is an awesome way of presenting unique numerical thoughts to more youthful learners (NCTM, 2001). However, questions encompassing whether Manipulatives are integral to the accomplishment of learners in Mathematics have cropped up over the years. Mcniel & Jarvin (2007:309) state that there are two primary topics to consider when looking at the wonder of Manipulatives. Firstly, they accept that Manipulatives can run a chance of learners being more concerned about having fun rather than genuine learning taking place and secondly, that Manipulatives might complicate learning as they must be used together with abstract information.

Moreover, Back (2013) has reservations on the adoption of Manipulatives to teach Mathematics and she addresses their viability. She was of the view that there are few studies that have demonstrated that Manipulatives contribute to high Mathematical achievement. Additionally, Muhammad, Sani, Abdullahi and Bayro (2023) argue that learners are incapable of seeing the significance and connection of Manipulatives to the concept that's being taught. For instance, a learner may comprehend place value when working on a Place Value mat but is unable do the work in their books. A learner could also learn the basic principle of grouping when using Manipulatives but fail to link it to the multiplication sign (Odum, 2022).

It's possible that some teachers in South Africa lack the necessary training to handle Manipulatives effectively in the classroom, which leads learners to using them improperly. This is one reason why the findings mentioned above might be true. Furthermore. In classrooms where multiple languages are spoken, it may be necessary to provide instructions and explanations in different languages along with Manipulatives.

1.9.2 Effective Manipulatives use in the classroom

Wilkie and Roche (2022) caution against the abuse of Manipulatives in the classroom. They express that it is important that learners do not depend on using

Manipulatives for displaying numbers, but that they create mental imagery related with these materials and can at that point work with “imagined” situations (Wilkie and Roche, 2022). When teachers employ Manipulatives in their Mathematical instruction, it should be matched with a clear understanding of when and how they should be used because all Manipulatives serve a different function at different times (Muhammed et al., 2023).

An example of the above statement is echoed in the CAPS document (2012), which reads that many teachers mistaken the function of flash cards. They use them to teach calculation when their main objective is to develop place value skills. It is further expected for teachers to limit telling/showing learners exactly what to do with the objects, as it will render the process ineffective. They should simply act as facilitators, because, when teachers provide the learners with specific directions on how to manipulate the object, they stand a chance of depending on the Manipulatives and using them to find answers as opposed to exploring a concept (Van de Walle, Karp and Bay-Williams, 2020). Teachers are required to bear in mind that though Manipulatives are helpful, learners need to comprehend the Mathematical concept at hand and not just move objects around without real learning occurring.

Moreover, Charles-Cole (2020) explained that the objects used should be appropriate for the Mathematical topic at hand. As learners progress and develop thinking and problem-solving skills, it is mandatory for the materials to be adapted to suit learner needs. Lange (2021) exclaimed that teachers should frequently allow learners to free-play, especially when the aim of the activity is open-ended for learners to make their own discovery and meaning. Basargekar and Lillard, (2021) accept that through the assessment of many studies that have been conducted over the years, there are clear signs that teachers are required to:

- Be clear as to why they give particular resources;
- Perceive the link between the practical task, the visual symbolism made and the abstract Mathematics involved.

- See the use of Manipulatives in portion as a social activity which can help with intelligent discussions between learners and adults. This means that even when Manipulatives are part of a lesson, the teacher should allow for group/peer work.
- Allow for questions and discussions related to the work to support their numerical thinking.

1.9.3 Summary of preliminary literature review

The literature review summarised existing literature pertaining to the importance of using Manipulatives in the classroom as well as how they should be used. The author sought to highlight contrasting views regarding the use of Manipulatives.

1.10 THEORETICAL FRAMEWORK

This study employed Lev Vygotsky's Sociocultural Theory. The researcher proposed that the theory offers valuable insight and perspective into how lessons can be effectively carried in classrooms, the process of how learners acquire knowledge and finally, how learners develop understanding of Mathematical concepts.

Sociocultural Theory

Lev Vygotsky (1978) conceptualised the sociocultural theory as a venturing stone to understanding that learning is a gradual process which considers the social context of a learner (Vygotsky, 1978). Lev Vygotsky contends that learners acquire knowledge through social interaction; thus, the theory does not only centre on adults and collaborative work, but also on the cultural beliefs and social convictions that surround how learning should take place (Vyogtsky, 1978).

According to Vygotsky, each child possesses basic mental capacities formed by their backgrounds which allow them to create logic. These capacities are called "tools of intellectual adaptation" (Mcleod, 2022). Adopting Vygotsky's theory to instruct Mathematics requires learners to be the heroes of their own learning; therefore, teachers ought to create exercises where they ask learners more

questions to probe their prior knowledge and garner what the learners already know about the concept instead of just passing down information while the learners passively receive (Mcleod, 2022). Besides, teachers can always bet for collaborative instead of individual work, particularly when presenting a new topic. Activities should look to stimulate the pupils' zone of proximal development, and lastly, they should be lively and encourage social interaction (Mcleod, 2022).

One of the foremost important concepts found within the process of sociocultural learning is the Zone of Proximal Development (ZPD), which helps in understanding how learners secure information. Vygotsky (1978:86), defines the ZPD as “[t]he distance between the actual developmental level as determined by independent problem solving and the level of potential development as determined by problem solving under adult guidance or in collaboration with more capable peers”. This means, it is the duty of the teacher to supply a learner with stimulating exercises and support them to reach higher levels of their ZPD.

In sum, theorists have concluded that the use of Manipulatives is important because they are concrete and limit the learner's need to think symbolically or abstractly. They suggest that the manipulation and exploration of objects will naturally lead learners to identify the abstract symbols of those objects.

1.11 METHODOLOGY

This research study was qualitative in nature with the aim of providing an in-depth analysis into the use of Manipulatives in the Grade 1 class. According to Cohen, Manion and Morrison (2018), qualitative research studies show how people analyse and view the world. It is a research method that adopts practices such as observation or case study, eventually leading to a descriptive and narrative account of a practice.

Applying qualitative research in this study enabled the researcher to answer whether Manipulatives are used in the classroom and if they are, how the teacher was making the lesson meaningful. This was done by observing participants as

well as analysing information gathered from interviews within an interpretivist framework.

1.11.1 Research paradigm

This study was guided by the Interpretivist paradigm. Interpretivism is an approach that believes that the motivations and reasoning of individuals is essential to finding meaning of the data collected (Kivunja and Kuyini, 2017). The researcher collected varying information on the topic being studied through observation, and then entered into a dialogue with the participants to eventually derive meaning and understanding on the research topic.

The interpretivist paradigm allowed the researcher to consider the experiences and feelings of Mathematics teachers instead of relying on their own views. Finally, interpretivism ascertained that the researcher did not deviate from the borders of the aim and to instead covered the most crucial features of the research design (Du Plessies & Mestry, 2019).

1.11.2 Research approach

This research study explored the Use of Manipulatives in the Grade 1 Mathematics class. The approach was qualitative in nature and objectively analysed the information all participants provided on the research topic,

1.11.3 Research design

This research study employed a case study research design. A case study is a suitable research design if you wish to learn precise, contextualised, in-depth information on a particular real-world topic. It enables one to investigate the case's salient features, interpretations, and ramifications (McCombes, 2019). The researcher achieved this by observing the classroom setting of two schools, and accurately described the structure of whether concrete materials were used and how.

The researcher further unleashed the lived experiences of teachers in the Mathematics classroom and some of the challenges they faced; which required

them to acknowledge and set aside their perceptions and prejudices. Finally, a case study design provided the researcher with room to firstly describe the reality of what was happening in the Mathematics classrooms objectively and analyse the description by referring to existing theories about the phenomenon.

1.12 INSTRUMENTS FOR DATA COLLECTION

The instruments for data collection were classroom observations as well as semi-structured interviews. The open-ended interviews of the teachers were based on the study questions (Mashuri, Sarib, Alhabsyi, Syam, 2022). The researcher employed probing as part of seeking clarity and gaining greater insight.

The focus of the interviews was to understand the teachers' views and challenges when using Manipulatives and any other helpful information. Furthermore, Mathematical lesson observations took place to observe how the teacher and his/her learners engaged with Manipulatives; and further analysed the strategies teachers adopted when teaching concepts (Smit and Onwuegbuzie, 2018). An observation schedule was used to guide this.

1.13 STUDY SITE

The study took place at 2 different schools, in a total of five grade 1 classrooms. The researcher was of the view that the challenges experienced in one school may have not been the realities of another school thus, incorporating a multisite study provided them with a larger and more diverse sample (Jenkins, Slemon, Saah and Oliffe, 2018).

1.13.1 Participants selection

Purposive sampling was used because grade 1 classrooms were needed to be the focus of the research. When a researcher selects participants at his or her own discretion, this is known as "purposive sampling" (Andrande, 2020:87). The researcher was responsible for picking the best possible research locations and samples that would meet the research objectives.

1.14 DATA ANALYSIS

Data was collected from two schools. Coding and Thematic Analysis were employed to analyse the data (See summary in Table 1). A brief description of each method will be provided below.

Research Question	School	Data Collection	Data Analysis
1. What kind of Manipulatives are teachers using when teaching Mathematics?	A B	<ul style="list-style-type: none"> • Observation • Semi-Structured Interview 	1. Thematic Analysis
2. How do grade 1 teachers teach Mathematics with Manipulatives?	A B	<ul style="list-style-type: none"> • Observation 	1. Thematic Analysis
3. What challenges are teachers facing when teaching Mathematics using Manipulatives?	A B	<ul style="list-style-type: none"> • Observation • Semi-structured Interview 	1. Thematic Analysis

Table 1: Data analysis summary

1.15 ETHICAL CONSIDERATIONS

The research proposal was presented to Committee of the University of the Free State to receive Ethical Clearance. Next, the participants of the study were made aware of the purpose, risks and benefits associated with taking part in the research. All work in the study is free of plagiarism and encapsulates accurate data. Finally, all participants were kept anonymous, and no facial photos were taken nor published of the learners and teachers.

1.15.1 Dependability

In qualitative research, reliability and dependability are related. Dependability is the degree to which a study may be conducted again and yield identical results by a different researcher (Stahl and King, 2019).

To achieve dependability, the researcher provided a research process that was well documented and logical by keeping all records of observation notes as well as interview recordings and transcripts (Stahl and King, 2019).

1.15.2 Confirmability

Confirmability is the process of ensuring that the interpretations and findings of the study stem from the data (Stahl and King, 2019). The researcher showed how they reached the conclusions through justification and referring to previous research. They went a step further by stating the rationale behind their theoretical, analytical, and methodological choices found in the study.

1.15.3 Transferability

According to Nassaji, (2020), in order to allow readers to evaluate if the study's conclusions are applicable to different contexts or demographics, thorough explanations of the research context, methodology, and conclusions are necessary to ensure transferability in qualitative research.

The researcher improved the transferability of the study by employing a variety of data gathering techniques, such as conducting semi-structured interviews and making observations. To gather a variety of experiences, the researcher actively

sought out participant viewpoints on the use of Manipulatives to teach mathematics.

In addition, the researcher meticulously recorded the research procedure and acknowledged any limitations or biases. The researcher also urged readers to thoughtfully assess the applicability of the findings to their own situations, promoting transferability as indicated by Nassaji (2020).

1.15.4 Comfortability

Throughout the research process, it is necessary to create a respectful and supportive environment for participants in qualitative research to ensure their comfort (Nassaji, 2020). This entails cultivating a strong connection, developing confidence, and guaranteeing privacy to promote transparent and sincere communication.

The researcher made sure the participants were safe by giving them detailed information on the study's goals, methods, and any risks involved (Nassaji, 2020). The participants were granted the freedom to articulate their thoughts and ideas using their own vocabulary and language, and at their preferred pace, in order to uphold cultural norms and honour their own personal preferences. The researcher created an environment that was comfortable and empowering for the participants, which allowed for the collection of valuable and relevant data.

1.16 SUMMARY OF CHAPTER 1

This study is about exploring the use of resources in the Grade 1 Mathematics classroom. It was conducted in South Africa, specifically the Motheo District, at two schools. The research proposal comprises of introducing the topic, evaluating certain literature for the literature review and finally the methodology. This qualitative study employed purposive sampling and semi-structured interviews and observations were the tools for extracting data.

1.17 ORGANISATION OF CHAPTERS

- Chapter 1: This chapter focuses on the introduction and background of the study. A rationale is provided as well as definition of operational terms.
- Chapter 2: Entails the literature review and theoretical framework of the topic at hand.
- Chapter 3: This chapter will summarise the research methodology as well as the design.
- Chapter 4: This chapter looks at the data analysis and findings.
- Chapter 5: This chapter will provide conclusions, and recommendations drawn from the research.

CHAPTER 2 LITERATURE REVIEW AND THEORETICAL FRAMEWORK

2.1 INTRODUCTION

The focus of this chapter was to review relevant literature provided a theoretical framework in relation to Manipulatives in the context of teaching Grade 1 Mathematics. An overview and analysis of seminal works on Manipulatives in primary education open the chapter. By doing this, the definition of Manipulatives was established, along with the advantages and disadvantages of using them in Grade 1 classrooms. The researcher conducted a multi-contextual analysis of Manipulatives; concentrating on three distinct contexts: the global environment, continental viewpoints, and from a South African context. Although the study was focused on South African classrooms, the literary sources were chosen from a variety of perspectives to present a comprehensive understanding of Manipulatives and teachers' experiences of them in the classroom from a variety of angles. A theoretical framework that serves as a road map for comprehending the vital role that Manipulatives play in Grade 1 Mathematics classrooms is presented as the chapter's conclusion. It also offers suggestions on how to successfully incorporate them into teaching and learning.

2.2 BACKGROUND/PERSPECTIVES ON MANIPULATIVES

“The hand is the instrument of intelligence. The child needs to manipulate objects and to gain experience by touching and handling.” Doctor Maria Montessori

The phenomena of employing Manipulatives when teaching Mathematics in contemporary classrooms owes guidance to seminal researchers such as Jean Piaget (1964), Jerome Bruner (1960), and Maria Montessori (1912). Maria Montessori, an esteemed teacher from 1870 to 1952, played a pioneering role in designing instructional materials that were specifically tailored for the purpose of teaching Mathematical concepts. As written by Txabarri and Zuazagoita (2022), an essential element of the Montessori approach lies in the adoption of Montessori materials- which are inventive and practical learning resources intended to

stimulate the cognitive domains of learners, foster a culture of inquiry, and ignite self-directed learning. In the Montessori approach, teaching Mathematics involves developing a strong grasp of key Mathematical concepts, including fractions, place value, and the fundamental arithmetic operations of subtraction, addition, multiplication, and division (Schumacher, 2021).

To start the Mathematical sequence, learners must first understand the concept of tens and units and then learn to match them with their respective symbols (Schumacher, 2021). Number Rods, Sand Numerals, Spindle Boxes, Cards and Counters are the primary tools that can be used in understanding this theoretical concept. The materials (Manipulatives) possess an alluring quality and are easy to use. Basargekar and Lilliard (2022) further write that the Montessori approach is grounded in principles of self-directed activity, kinaesthetic learning, and cooperative engagement.

Since Montessori programmes are primarily linked to excellent Mathematics ability, extensive research has further been done to support the effectiveness of enrolling learners in them during their formative years. For example, Lillard and Else-Quest (2006) documented a significant achievement gap in Mathematics between learners who were randomly assigned to attend a Montessori programme and those who were not – as was evidenced by higher standardised Mathematics test scores among the former group. This is in line with Vang's (2017) argument that standard early childhood education programmes benefit from using the Montessori method to improve the learning environment for Mathematics.

On the other hand, within the context of his learning theory, Jean Piaget places a strong emphasis on the use of Mathematical Manipulatives in the classroom. The three unique levels of cognitive knowledge – concrete, visual or representational, and abstract, are progressed through by youngsters according to Piaget (Pakpahan and Saragih, 2022). This means that when learners learn a new concept, they first need to explore it concretely before having a thorough abstract understanding of it. Lange (2021) adds that using Manipulatives during a Mathematics lesson provides learners with a chance to comprehensively

investigate a concept through a concrete approach. In turn, this may help them to understand a concept and further deepen their comprehension of the fundamental reasoning behind Mathematical procedures.

For example, when using Base Ten Blocks for the topic of Place Value, it allows learners to easily observe that the numerical composition of 10 ones is equivalent to 1 ten. This is achieved by means of allowing learners to count the unattached pieces (ones) while recognising that the said sum is equal to the combined pieces (tens) which is in line with the Piaget's theory that learners first need to learn in a concrete manner.

Furthermore, as written by Mcleod (2019), Bruner (1961) posited that learner's early encounters and interactions with concrete materials establishes a foundation for understanding abstract information at a later stage. This pedagogical approach of active learning whereby students are engaged in practical tasks is commonly known as constructivism and is considered an essential element that must be considered by teachers when preparing lessons for the Grade one classroom (Cofoner, 2020:8).

2.2.1 International background

To provide some context for this study's background as a way of establishing how long the phenomena of Manipulatives has been in existence, the researcher started by citing older studies. Firstly, an article titled, "A Forum for Researchers: The Manipulatives Materials Strategy: The Latest Pied Piper?" by Friedman (1978), focused on primary school education where he conducted an analysis of fifteen studies dating prior to 1970. The outcomes of his review indicated that Manipulatives presented benefits for the early education of learners, however, their applicability in advancing the learning capabilities of older individuals appeared to be limited.

Prior to this, Suydam and Higgins (1977) published a report that covered twenty studies pertaining to students' academic progression from kindergarten through Grade 8, where they found that learners who had the chance to manipulate

materials and use pictorial representations during problem-solving activities, demonstrated significantly higher achievement (Suydam and Higgins, 1977). Although these studies may be somewhat dated, they are still important because they conclusively determined that the use of Manipulatives materials during the teaching of Mathematics resulted in higher levels of accomplishment than their absence and perhaps forms the basis for why teachers still believe in them today.

Moreover, in recent decades, several teachers and experts in early childhood education have adopted Manipulatives in the classroom despite the varying outcomes of research evaluating their benefits. For instance, current state benchmarks like the Florida Mathematics Standards, developed in partnership with the National Council for Teachers of Mathematics (NCTM), require representational models as a key component of Mathematics instruction. Pictures and material objects (Manipulatives) can both be used to form these representations (Furner and Worrel, 2017).

Furthermore, the Australian curriculum Assessment and Reporting Authority's Educational modules, (ACARA, 2020) propose that learners ought to manipulate objects to construct patterns and models; while the NSW Syllabus for the Australian Curriculum: Mathematics K–10 Syllabus (NESA, 2019) writes that the use of tangible and physical materials during teaching from Early Childhood to Grade 7, is a pivotal constituent of Mathematics education (Quigley, 2020).

Additionally, the Singapore Mathematics Syllabus for Primary One to Six, released by the Ministry of Education (2012), recommends the use of physical resources to help students explore and comprehend abstract Mathematical concepts; whilst in Hungary, Manipulatives are regarded as an indispensable tool for the early development of Mathematical skills, particularly for individuals below the age of eleven (Back, 2013). This was determined through the analysis of one lesson that Jenni Back (2013) had monitored, where the emphasis was placed on introducing the numerical quantity of six to the learners. The teacher employed a diverse range of Manipulatives in her instructional session including, but not limited to, analogue clock faces, dominoes, Cuisenaire rods and Hungarian number pictures. The

above International beliefs suggest that there is real efficacy in using Manipulatives in the educational setting given that students use them in accordance with the particular subject matter being taught (Lange, 2021).

2.2.2 African Background

In the context of Nigeria, Mathematics is regarded as one of the most essential subjects. Regrettably, performance levels in the subject have been notably inadequate and vexing for nearly two decades and despite concerted efforts to rectify the persistently poor Mathematics outcomes, none have thus far been successful (Awofala and Lawani, 2020). However, a recent study conducted by Muhammed, Sani, Abdullahi and Bayro (2023) has provided evidence to suggest that the use of Manipulatives can serve as a significant means of enhancing academic performance in Nigeria.

Their study aimed to examine the effect of incorporating Manipulatives in the instruction of primary school Mathematics on the academic achievement of Nigerian students. A quasi-experimental design was employed wherein 40 students constituted the sample population for the investigation. The study involved the creation of Pretest-Posttest Mathematics Accomplishment Tests (PPMAT). The findings infer that the use of Manipulatives has a favourable influence on student” Mathematical proficiency. They further recommend that Manipulatives be maximised in primary school curriculums to enhance the Mathematical achievements (Muhammed et al., 2023).

Furthermore, the results are congruent with the sixth primary aim of elementary education as outlined in the National Policy on Education (2013) of the Nigerian state. The policy states that Mathematics ought to: “Provide an opportunity for the child to develop live Manipulatives skills that will enable the child to function effectively in society within the limits of the child’s capability” (Federal Republic of Nigeria, 2013:7).

The efficacy of Manipulatives within educational settings has further been proven through an empirical investigation that was undertaken in the geographic region

of Edo State, Nigeria. Aburime (2007) administered an examination to formulate a response to the problem of poor performance in Mathematics. The study involved the creation of eighteen fundamental concrete Manipulatives using conventional cardboard study as the primary material. The experimental group used the Manipulatives, whereas the control group refrained from using them. Upon collection of the scores from both groups, a statistical analysis showed that the experimental group, consisting of individuals who employed Manipulatives, exhibited superior performance. These findings serve as further confirmation that Mathematics Manipulatives occupy a crucial role in classroom instruction.

In Trinidad and Tobago, a country in the Caribbean, comparable comparison reports of poor Mathematics performance have also been found (Kalloo and Mohan, 2015). According to the Organisation for Economic Co-operation and Development's (OECD) Programme for International Student Assessment (PISA, 2015), a significant percentage of students, namely 52.3%, performed below the required level in Mathematics. Kalloo and Mohan (2015) acknowledged that the teaching practices of teachers within the Mathematics classroom served as a contributing factor to this issue. It was elucidated that in instances where concrete objects, such as Manipulatives were integrated into the pedagogical practices of Trinidad and Tobago, there was observable evidence of change in the levels of student engagement, aptitude towards learning, and their ability to effectively resolve Mathematics related problems. Furthermore, the use of Manipulatives in these classrooms resulted in favourable responses from students.

Similarly, the Ministry of Education (2015) asserts that Manipulatives materials are instrumental in promoting comprehensive understanding of Mathematical concepts among pupils in primary education within the neighbouring country of Ghana. It is widely acknowledged that the integration of Manipulative materials in classrooms affords students an advantageous opportunity to effectively investigate and comprehend complex concepts (Cope, 2015). Furthermore, students also show a capability for memory and recall of previously learned material.

1.2.3 South African Background

Upon entering South Africa, in 2014, a workshop was facilitated under the guidance of Lizel Meyer, an expert from the School of Open Learning at the University of the Free State located in Bethlehem. During the discussions, considerable attention was devoted to the use of Manipulatives concerning the five primary domains of Mathematics as delineated in the Curriculum and Assessment Policy Statement (CAPS): Numbers, Operations, and Relationships; Patterns, Functions, and Algebra; Space and Shape; Measurement; and Data Handling (University of the Free State, 2014).

It was ascertained that a variety of Manipulatives are employable in Mathematical instruction, many of which are economically inexpensive, if not gratuitous. An activity including pattern pieces was further pursued as a means of reflective examination regarding the potential impediments to the integration of Manipulatives that teachers may face, and the potential role of subject advisors in empowering teachers (University of the Free State, 2014). The trajectory for this kind of Mathematical education was set to commence in the year 2015. Capacity building interventions, in the form of workshops and coaching sessions, were envisaged to support subject advisors in their preparations for the annual Free State Mathematics summit (UFS, 2014).

These initiatives suggest that the Free State Department of Basic Education has prioritised ensuring that all stakeholders comprehend the value of incorporating Manipulatives into classroom pedagogy. Over and above that, it was of utmost significance to host such sessions as the Mathematical outcomes in the region were subpar, as evidenced within the Annual National Assessment of 2014.

Thankfully, soon thereafter, the Foundation Phase Initiative (FPI) embraced the concept of providing learners with experiential learning opportunities that facilitate exploration using concrete materials in the classroom. The FPI originated in 2017 as a collaborative undertaking between various organisations, including the Department of Basic Education, UNICEF South Africa, the LEGO Foundation, and

Care for Education. Its primary objective was to introduce Manipulatives in Grades R to 3 by means of play-based learning (Matangira, 2022).

The programme, established by the LEGO Foundation, demonstrated a firm commitment to furnishing primary school learners attending public schools with Six Bricks - Manipulatives - to facilitate creative and hands-on learning experiences (Matangira, 2022). This pedagogical approach shows that South Africa's education system centres around the concept of 'learning through play', which is interactive and engaging for young learners.

Furthermore, a research study authored by Weiss (2015:105) entitled "How the use of Manipulatives contributes to the development of problem-solving skills in Grade One learners in South Africa" offers a clear perspective on the advantageous nature of Manipulatives employed in the context of Grade 1 Mathematics classrooms. The findings of the study indicate that Manipulatives play a crucial role in laying a concrete foundation for learner's comprehension while engaging in problem-solving tasks.

However, although numerous South African literary works substantiate the significance of Manipulatives in the process of teaching Mathematics in the classroom, there remains a significant lack of evidence confirming whether teachers are implementing them. While research contains valuable information on how teachers can use them together with joined efforts from initiatives such as the LEGO foundation, there is still a crucial gap which requires thorough research to be conducted on whether teachers are using Manipulatives and their proficiency in doing so.

2.3 DEFINING MANIPULATIVES

The available body of evidence demonstrate that a crucial factor contributing to the academic achievement of pupils in Foundation Phase Mathematics classrooms, lies in their perceptual ability to physically engage with and manipulate objects through visual, tactile, and sensory means (Charles, 2020).

However, how does one define Manipulatives? According to Pacinello (2019), Mathematics Manipulatives refer to concrete objects that possess the potential to enhance both instructional and learning experiences. These may be regular tangible objects such as one's fingers, pebbles, and sticks, however, additional specialised Mathematical objects such as Mathematics link cubes and fraction tiles, can be used in conjunction with traditional teaching methods.

Meanwhile, Rowley (2020) notes that Mathematics Manipulatives are widely known as appealing concrete objects that help learners understand abstract concepts while also promoting social collaboration and classroom discussions. To further add onto this, according to Maboya et al., (2020), it is imperative that learners are provided with the opportunity to hear, see, and touch these Manipulatives in a multi-sensory manner. Doing so enables them to view the objects as concrete and tangible representations of numerical concepts that would otherwise be abstract and intangible.

Likewise, according to Adendorff (2020), Manipulatives are materials that aid in clarifying numerical concepts that are non-pictorial. For example, as stipulated by the official Curriculum Assessment Policy (CAPS) document, the concept of "mass" is mandated to be taught during the second academic term. One potential teaching method for initiating learners' understanding of the concept may involve the use of a measuring scale and diverse materials both within and beyond the classroom setting that learners would be able to measure using the scale. Visual and tactile learners will eventually embark on an engaging and exploratory journey towards developing their understanding of the concepts: "heavy and light".

Swan and Marshall (2010) concur with the idea that Manipulatives are physical objects that offer learners the opportunity to engage in tactile exploration, enabling them to take part in both conscious and unconscious thinking about the Mathematical topic at hand. This phenomenon coincides with Delport's (2021) observation that the conveying of Mathematical concepts can be effectively achieved via the manipulation of concrete objects. However, Charles-Cole (2020:30) observed that debates dating back several years have questioned the

definition of Manipulatives, given the ambiguity surrounding the 'concept' and its 'function'. She believes that the common definitions can be troublesome to comprehend due to linguistic diversity. For example, whilst concrete is often associated with hard and immovable, Manipulatives can be versatile and portable. Furthermore, the researcher has noted that the above definitions also fall flat in considering the varied ways in which Manipulatives can be used for creative classroom activities. For instance, while the original purpose of Dienes Blocks was to facilitate learner's understanding of numerical concepts such as addition/subtraction and place value, their own experience as a teacher has shown that these blocks may also be employed to teach the concept of repeating or growing patterns as per the Grade 1 curriculum.

Versatility is applicable in the South African educational context, where many schools in quintiles 1-3 face challenges in obtaining traditional Mathematics Manipulatives, such as Cuisenaire Rods, due to financial limitations (Du Plessis and Mestry, 2020). Consequently, teachers are compelled to employ improvised teaching methods in the classroom. It is crucial for teachers to recognize that Manipulatives have purposes beyond their fundamental function. For example, clay possesses the qualities of Manipulatives and can be modified in various ways. It can be used for counting or cutting precise shapes, which is referred to as 'Dual Representation' (Robinson, Osana, Kotsopoulos, and Sprinkgerlink's 2019). Dual representation is a construct wherein a Manipulative is an object in its own right but can act as an image of an abstract Mathematical concept (i.e.. pupil's pencils can be seen as "chocolate" when teaching division) (Robinson et al., 2019).

In contrast, Gifford, Back, and Griffiths (2015) explained Manipulatives as being either structured or unstructured. Structured Manipulatives are materials that represent one specific conceptual structure. An example of a structured Manipulatives is the Cuisenaire Rod, originating from the work of George Cuisenaire (1891-1975), a Belgian researcher. They are specifically intended to teach the concept of fractions.

On the other hand, unstructured Manipulatives refer to objects that possess greater adaptability, enabling them to facilitate unconstrained exploration and manipulation. As such, unstructured Manipulatives are typically employed in problem-solving tasks such as grains of rice (Gifford et al., 2015).

Presently, a myriad of commercially available Mathematics Manipulatives occupies the shelves of numerous school classrooms (Lange, 2021). They are vital instructional aids for teachers and young learners alike. Mntunjani, Adendorff and Siyepu (2018) contend that they afford learners with a hands-on opportunity to investigate and acquire knowledge through practical experiences. Furthermore, when learners are manipulating these objects, it creates a conducive environment for incidental learning to take place, which contrasts with a scenario where they would passively receive instruction through merely listening and observing.

2.4 TYPES OF MATHEMATICS MANIPULATIVES

Theory guides us into what Manipulatives are and why they should form part of every Mathematics class however, few questions may be lingering in the readers minds such as: what kind of Manipulatives should teachers have? Do they need to be bought or are teachers able to make their own Manipulatives using raw/waste materials? In fact, are there Manipulatives that are considered correct and/or incorrect for the classroom? The following section will seek to formulate a response to these questions.

Literature proves that Manipulatives may range from basic items such as buttons or stones to more complex commercially produced materials that are tailored to satisfy general or specific educational objectives (Furner & Worrel, 2017). Teachers have the option of utilising pre-made commercial Manipulatives, implement self-constructed techniques, or engage in cooperative creation with students. This infers that Manipulatives are tangible objects accessible within our everyday surroundings which learners may use to engage in abstract thinking.

In other words, as suggested by Laski et al., (2017), Manipulatives may simply refer to any material or object that can be employed to concretely simplify a Mathematical concept. Ultimately, Manipulatives in Mathematical instruction aim to decrease the abstract nature associated with concepts, thereby affording learners the opportunity to engage in enjoyable and playful learning experiences. Physical Manipulatives can be described as using objects, tools, models, or mechanisms to show a better understanding of a Mathematical topic while problem solving. Jones and Tiller (2017) closely explains that ‘Manipulatives’ are tools that teachers use to help learners understand concepts better. Manipulatives can be toys and objects which learners can touch and manipulate with their hands. The materials come in many different shapes and forms to help strengthen understanding of basic counting and matching, creating patterns, grouping and sequencing in learners (Luneta, 2020).

Furthermore, Rowland (2010) reinforced the idea that there is a variety of resources one can use to teach in a symbolic way. In an 'easy to understand' table, he provided examples of such resources and how to categorise them.

Everyday Objects	Objects designed for Mathematics teaching	Pictures or diagrams
Dolls, coins, weighing scales, calculators, clocks, rulers, bottles, jugs, squares, calendars.	Base- 10 apparatus, multiplying cubes, 2D and 3D shapes, shapes divided into fractional parts.	Bar charts, number lines, pictures of purses containing different coins, hundred charts.

Table 2: Resources for Mathematics teaching (Rowland, 2010)



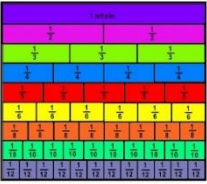
The tabulated information above delineates the classification of Manipulatives into three distinct categories namely:





1. Everyday objects that are readily present within the ambit of the learners' environment.
2. Objects that are designed for Mathematics teaching entail materials that possess a specific purpose and function; A teacher cannot use these objects to teach any other concepts besides those they are designed for; for example, it would be impractical to introduce the concept of 'addition and subtraction' using fractional parts however, it would be possible if the teacher utilises bottles tops from the Everyday Objects Category.
3. Pictures and Diagrams can be considered as two-dimensional, semi-abstract, visual images used to convey a particular concept or lesson. These resources are highly advantageous for individuals who learn predominately through their visual sense as they facilitate the process of meaning-making.

Moreover, Lyttle (2021) has classified Manipulatives into four categories: Formal, Informal, Environmental, and Digital however, due to the present study being limited to the discussion of physical Manipulatives, I will focus exclusively on the classification of formal and informal Manipulatives. Formal Manipulatives are usually specifically procured for classroom use and are instrumental in cultivating Mathematical patterns and deciphering underlying conceptual ideas. Various formal Manipulatives used in early childhood education include Cuisenaire rods, Numicon, and pattern blocks (Lyttle, 2021).

On the other hand, Informal Manipulatives are objects that are effortlessly accessible and can serve as symbols of patterns. For instance, three everyday items that one may find include pasta, sticks, and straws (Lyttle, 2021). In accordance with the knowledge and contextual groundwork I gained from Lyttle's work entitled: "How can the use of Manipulatives improve both Mathematical understanding and Mathematical language skills?" The researcher created Table 2.2 as an endeavour to offer novel illustrations of formal and informal Manipulatives tailored for targeted use within Grade 1 Mathematical pedagogy. The list should not be deemed exhaustive, thereby allowing for personal additions

of choice by the reader. The materials are designed for interaction and manipulation by learners and possess practical value within diverse educational contexts.

Formal Manipulatives	Description
<p>(a)</p>  <p>Cuisenaire Rods</p>	<p>Cuisenaire rods aid in fostering the understanding of basic arithmetic operations and imparting proficiency in fractional calculation. The rods known as Cuisenaire rods were developed by George Cuisenaire, a Belgian Primary School Teacher who was an experienced teacher. Cuisenaire demonstrated that students exhibited proficiency in traditional arithmetic upon being granted the opportunity to manipulate these instructional tools (Togah, 2020)</p>
<p>(b)</p>  <p>Abacus</p>	<p>Likely of Babylonian origin, the abacus is a computational device that employs moveable beads along a set of wires or rods, encased in a frame, to symbolise the positional system of base-ten. An abacus is identified as a forebear of contemporary digital calculators (Anam, Suteja, Septianto, Purnomo and Utami, 2020).</p>
<p>(c)</p>  <p>Fraction Strips</p>	<p>Learners are assisted in understanding that the same "whole" can be divided into various equal-sized portions using fraction strips (or fraction bars or fraction tiles). Students can see the fractional quantities as they move the strips and arrange them side by side (Lee and Lee, 2022).</p>

<p>(d)</p>  <p>Demonstration Clock</p>	<p>The intricate relationship between minutes and hours, the skillful act of telling time, and the accurate calculation of elapsed time can all be thoroughly investigated with geared clock Manipulatives. The hour and minute hands of the clock are colour-coded to correspond with the hour and minute markers on the dial. Students can understand and interpret the workings of an analog clock thanks to the design of this educational aid (Rahmawati, 2021)</p>
<p>(e)</p>  <p>Pattern Blocks</p>	<p>Pattern Blocks serve as an effective tool for facilitating students' comprehension of diverse Mathematical concepts, encompassing but not limited to congruence, similarity, symmetry, area, perimeter, patterns, functions, fractions, and graphing (Kuennen and Beam, 2020).</p>
<p>Informal Manipulatives</p>	<p>Description</p>
<p>(f)</p>  <p>Stones</p>	<p>Within the proximal surroundings of learners, stones are present and can serve a purposeful role in facilitating their understanding of fundamental Mathematical concepts. Specifically, stones enable learners to enhance their numerical counting abilities, their knowledge of varied numerical representations, their capacity to subitise, and their mastery of number bonds, amongst other Mathematical concepts (White, 2021).</p>
<p>(g)</p>  <p>Ice-cream sticks</p>	<p>The principal aim of Ice cream stick Mathematics is to heighten cognizance of numerical values, for example: "What does a collection of 100 popsicle sticks appear as?" These tools hold the capability of being applied across various proficiency tiers and towards a diverse range of activities (Paddock, 1992).</p>




<p>(h)</p>  <p>Buttons</p>	<p>Coloured buttons or counters are highly suitable resources for facilitating practical engagement with Mathematical concepts. Additionally, they are well-suited for sorting games (Staake, 2020).</p>
<p>(i)</p>  <p>Play Cards</p>	<p>Card games can be deemed as efficacious in cultivating a diverse set of critical skills, including but not limited to, problem-solving, decision-making, impulse control, compliance with rules and instructions, and effective communication with one's peers. Card games serve as an educational instrument for guiding learners in conflict resolution and nurturing their moral principles (Singh, Hoon, Nasir, Ramley, Rasid and Meng, 2021).</p>
<p>(j)</p>  <p>Empty Soda Bottles</p>	<p>Empty soda bottles present a commendable opportunity for learners to refine their skills in addition and subtraction, whilst simultaneously familiarising themselves with fundamental concepts pertaining to measurement and data handling (Milani, 2020).</p>

Table 3: Formal and Informal Manipulatives (own illustration)

2.5 RATIONALE FOR USING MANIPULATIVES

According to McDonough (2016), Manipulatives stimulate learner's number sense, facilitates their interpretation of symbolic notations (plus and minus), and ultimately helps them to thoroughly understand Mathematical concepts. Manipulatives further allow teachers to obtain a picture of learner's performance and distinguish any misunderstandings that they may have, thereby facilitating in the development of tailored intervention strategies (Hurst and Linsell, 2020).

This study remained consistent with that of Rowly (2020) who earlier conducted a quantitative investigation which aimed to illuminate the influence of Manipulatives on the comprehension and acquisition of Mathematical concepts on learners. His findings reiterated the idea that Manipulatives possess the capacity to foster the learning outcomes of students. Rowly (2020) explains that Manipulatives serve to enhance the acquisition of Mathematical understanding, problem-solving abilities, creative thinking, while simultaneously mitigating the anxiety learners feel towards the subject. Furthermore, he touched on the fact that the inclusion of Manipulatives within educational settings grants opportunities for learners to engage in meaningful exploration and imaginatively driven endeavours which ultimately mitigate the presence of tediousness and boredom amongst the learners (p. 20). This finding aligns with the observations of Muhammad et al. (2023), who posited that Manipulatives tend to heighten learner's engagement and enjoyment during a Mathematics lesson. Both studies discovered that Manipulatives lead to a reduction in boredom and increase pleasure for learners. Although the existing research on the advantages of using Manipulatives for instructional purposes is extensive, it remains inconsistent. While many studies have demonstrated that Manipulatives facilitate learning, others have identified them as a hindrance to acquiring knowledge.

In 2013, Carbonneau, Marley, and Selig conducted a meta-analysis which systematically examined and compared 55 studies pertaining to the utilisation of Manipulatives in Mathematics education. The findings suggest that Manipulatives offer advantages in facilitating learning, however, such advantages were observed to be contingent upon specific contextual conditions. For example, any contrasts that were found within the benefits of Manipulatives, were related to which content was being taught; it seemed that Manipulatives were more profitable for learning fractions than for learning calculations (Carbonneau et al., 2013).

The results further revealed that Manipulatives exhibited a limited degree of effectiveness for learners between three and six years of age. Significant advantages were scarce, and in some instances, undesirable outcomes were observed. Regrettably, the findings fell short in relation to the inclusion of students

in the first Grade (aged six - seven) which would have been more beneficial for this study. Nonetheless, when considering Jean Piaget's stages of Cognitive Development, it can still be concluded that learners in the first grade will derive greater benefits from the use of Manipulatives given that they are situated at the Concrete Operational Stage of Development.

Kul, Celik, and Aksu (2018) conducted a study that arrived at a similar conclusion, which is of a more current nature. Fifty-four experimental studies conducted between 2005 and 2016 indicated that using Manipulatives in Mathematics instruction failed to demonstrate a significant improvement in achievement in comparison to teaching without Manipulatives. There was no instance in which one group demonstrated superior performance over the other. However, despite this, Kul et al. (2018:322) ascertained that Manipulatives can foster an enhanced level of Mathematical engagement among learners. However, Maboya et al. (2020) posited that teachers and researchers should acknowledge that the mere use of Manipulatives alone does not ensure optimal learning outcomes. Teachers need to have thorough understanding regarding the correct use of Manipulatives within an instructional setting. Therefore, the specific Mathematical concept being taught should also dictate the appropriateness of the Manipulatives selected during instruction.

The authors go on to contend that in instances where teachers lack the "know-how" on the proper employment of Manipulatives, learners may become confused and view them as simple toys, ultimately resulting in a missed opportunity to leverage Manipulatives for Mathematical instruction (p.5415). This remained in alignment with Carbonneau et al., (2013) study, that the effectiveness of Manipulatives as instructional tools is contingent upon the specific context in which they are used - a topic which will be discussed in more detail later.

Furthermore, Quigley (2021) found that Manipulatives hold significance as pedagogical tools that assist learners across multiple academic stages in the subject of Mathematics. The use of Manipulatives is beneficial not only for individuals who encounter academic difficulties, but also for those who possess

advanced academic skills. They serve as a powerful tool for enabling learners with a weak Mathematics foundation to explore an abstract idea in a concrete manner (Jones and Tiller, 2017), whilst offering learners with advanced Mathematical abilities to explore what they have learned and take their Mathematical knowledge to the next level.

Based on the above arguments, should Manipulatives form part of a basic early childhood classroom? Several scholarly works, such as that of Maboya et al. (2020), have observed that Manipulatives should be employed, albeit with caution, given that a supportive atmosphere is cultivated to facilitate rather than impede learning.

2.6 EFFECTIVE TEACHING USING MATHEMATICS MANIPULATIVES

The ancient Chinese proverb, "I hear and I forget, I see and I remember, I do and I understand," implies that significant factors warrant contemplation when incorporating Mathematics Manipulatives. What is the best method that a teacher can use in teaching Mathematics? How might teachers facilitate the most efficacious learning for learners? Are there strategies available for instructing Mathematics in an engaging and impactful manner while satisfying the requirements of the CAPS curriculum? By assumption, the best approach is that which not only enhances the educational performance of learners but also positively impacts their perspective towards Mathematics. Below, I will attempt to demonstrate how to teach using Manipulatives as per various literatures, by creating four separate categories: CRA Method, Choosing Appropriate Manipulatives, Social Constructivism and Creating a Stimulating environment.

2.6.1 Concrete, Representational, Abstract Model (CRA)

Learners learn concepts more effectively when their thinking develops through three hierarchical levels of the inactive (concrete), iconic (pictorial), and symbolic (abstract), according to research by psychologists Jean Piaget (1936) and Jerome

Bruner (1961). Therefore, for students to grasp Mathematical concepts and procedures, Manipulatives would represent knowledge at the concrete level.

To examine the derivation of the CRA (Concrete-Representational-Abstract) approach, it is necessary to harken back to the pedagogical methodologies of the 1960s, during which time cognitive scientist Jerome Bruner posited this approach as a mechanism of furnishing learners with supportive structures for educational advancement. He believed that the abstract nature of learning, specifically of Mathematics, was perceived as a mystery by a significant proportion of young learners. As such, it became imperative that appropriate scaffolding techniques such as the incorporation of Mathematical representations and Manipulatives be employed (Milton, Flores, Moore, Taylor, Burton, 2018).

During CRA instruction, the teacher provides students with the opportunity to explore and experiment with Mathematical ideas firstly in a tangible way whilst facilitating the development of critical thinking skills and fostering a lifelong love of learning in learners. The assortment of teaching aids used in the lesson may include, but not limited to, various types of fruit, base ten blocks, and fraction bars (Johnson, 2023). Once learners have mastered the Mathematics concept using concrete materials, they are then presented with pictorial-based problems. These typically encompass visual representations of the tangible objects that were previously utilised for example, worksheets where learners add fruits together. In the end, learners will then be introduced to only abstract problems i.e., numbers and symbols (Johnson, 2023).

Due to this study focusing on Physical Manipulatives, I will further engage on the Concrete Stage of the CRA method to gain greater clarity into what the environment in the classroom should look like during this stage.

(a) Concrete stage

This phase is the 'doing' stage. The process commences with the teacher modelling the use of tactile resources to the learners. An illustration of this is in a lesson where the teacher models grouping using buttons. The teacher would

demonstrate the process by counting audibly and arranging the buttons in a tactile manner. Subsequently, learners then engage in self-directed learning with their own Manipulatives, which could include items such as stones, blocks, and buttons. This act of engaging with tangible entities promotes enhanced memory acquisition (Gray, 2020). The researcher suggests that this stage accommodates a variety of learning styles. The obvious one is kinaesthetic or tactile. The students explore the concrete materials as a means of promoting cognitive development and facilitating learning. These materials also afford learners the opportunity to see the various processes in solving a problem, thereby further inducing visual learning.

Moreover, it has been observed that when learners engage in group-based activities involving Manipulatives, they demonstrate an inclination to engage in discussions about the topic and share their progress and actions. Individuals with an auditory learning style end up acquiring knowledge through this engagement (Nugroho and Jailiani, 2019:32). Thus, teachers should establish a conducive learning atmosphere that fosters peer discussions and group work among young learners while engaging in Manipulatives activities.

A key pedagogical consideration when working with Manipulatives is that learners should be repeatedly afforded ample opportunities, at every stage of CRA, to engage in deliberate practice and attain mastery of essential skills. It is also important for the teacher to give the learners an opportunity to go back and forth between the stages as and when required (Nugroho and Jailani, 2019).

2.6.2 Choose appropriate Manipulatives - the simpler the better

First and foremost, the Manipulatives chosen in a specific lesson should be relevant to the topic which the teacher would be covering for the day (Quigley, 2021). It would make no practical sense to employ concrete clocks to teach the concept of addition. (Refer back to Rowlands resources for teaching in 2.5). Secondly, teachers should further pay attention to Carbonneau (2020) who highlights the significance of the learner's familiarity with the Manipulatives to mitigate them being distracted by it. If a child is highly stimulated by the various attributes of the Manipulatives, there is a possibility that it would not serve as an

effective means of representing a distinct Mathematical construct for the child as he/she would simply be too distracted by it. This is in line with Charles Cole's study, (2020) who added that certain learners may perceive Manipulatives as disruptive, particularly when they closely mimic everyday items. This stimulation impedes their ability to focus and engage in the learning process effectively. The caution here is that the mere physical attributes of Manipulatives have the potential to distract students' ability to engage in problem-solving activities.

Therefore, teachers must prudently opt for Manipulatives that aim to concentrate learners' focus solely on the Mathematical concept it embodies and nothing else. In simple terms, the objects do not need to be full of many colours and features, in fact, the simpler the better. It is also incumbent upon teachers to ensure that students are given sufficient opportunities to establish meaningful connections between the Manipulatives and the Mathematical concepts (Laski et al., 2015). This can be done by using the same Manipulatives a few times to solve problems and create deeper meaning of basic Mathematical concepts.

2.6.3 Social Constructivism

Because social constructivism is built on student involvement, discussion, and sharing, it is also known as collaborative learning. With this instructional strategy, a variety of groupings and interactive teaching techniques are possible. According to Burr and Dick (2017), these could include whole class talks, small group conversations, or students working in pairs on predetermined projects or assignments.

The foundation of the theory, according to Gough (2017), is that students collaborate in groups to share ideas, brainstorm, look for causes and effects, find solutions to issues, or simply produce something new to supplement their prior knowledge. Social constructivism holds that knowledge is a common experience that develops from social interaction rather than being a personal property. Students obtain information and experience necessary for leading successful lives as they interact with others and their physical and intangible surroundings (Gough, 2017). Additionally, an insightful study by Akpan, Igwe, Mpamah, and Okoro

(2020:52) noted that social constructivism teaching methodologies can be divided into two main groups that teachers can adopt when instructing Mathematics using Manipulatives, namely: discussion and activity/group work. Following is a quick discussion of these techniques:

(a) Discussion teaching method:

A discussion method is a strategy that employs directed interaction to emphasise a particular subject matter with the goal of assisting the students (Akpan et al., 2020). Erciyas (2020) claims that the method, despite taking a lot of time, enhances learning by enabling students to strengthen their communication skills and mental talents like critical thinking, introspective thinking, and evaluating opposing ideas. With this approach, the teacher serves as a facilitator. The teacher encourages the students to learn by doing things for themselves through thoughtful dialogue. Furthermore, teachers and students would also go into detail during these conversations about a specific arithmetic topic. This can be achieved through conversations in small groups or with the entire class (Akpan et al., 2020). Each student is free to voice their ideas on a particular subject, but the discussion is facilitated by the teacher. Rules are established from the beginning to avoid turmoil. According to Erciyas (2020), this method makes students more involved in the class, improves student retention, and promotes conversation.

(b) Activity/Group work: small groups of students collaborate to complete a learning objective using this teaching strategy. Within the group, each student assumes a position that may be official or informal and that frequently changes (Akpan et al., 2020). It focuses on the contemplation and reasoning of the students as they build their own learning. In other words, should a teacher give learners a problem solving activity involving sharing, it would involve the child figuring out what they already know, what they need to know, and how and where to get fresh knowledge that could help them solve the problem. By encouraging, directing, and overseeing the learning process, the teacher's job, once again, is to focus on facilitate the learning (Akpan et al., 2020).

2.6.4 Create a stimulating, collaborative environment

Lastly, Odum (2022) recommends that students should not be relegated to the passive role of mere listeners and observers, but rather, they should be offered opportunities to actively participate and engage with the subject matter at hand as well enter discussions with their peers. This finding is in concurrence with that of Delport (2021), who asserts the significance of teachers affording their learners with free time to engage in Manipulatives play. This opportunity presents learners with the prospect of delving into their own questions and producing a diverse range of responses.

However, Carbonneau et al. (2013), posit that the introduction of Manipulatives to students with insufficient or inadequate guidance and direction from teachers can lead to off-task behaviour by the learners, while an excessive amount of instruction may inhibit the creative and meaningful engagement of students with these materials and is definitely not recommended; therefore, it is necessary for teachers to act as facilitators and observe that learners do not move too much away from the activity at hand.

Furthermore, Larbi et al., (2016) asserts that Manipulatives should be regarded as part of a comprehensive teaching programme. Teachers should still use other various teaching strategies, such as pictorial, verbal, symbolic, and real-world stimuli. Similarly, just as Vang (2017) lamented, it is imperative to employ Manipulatives as a complementary tool in teaching practices rather than a substitute for other strategies. Furner et al., (2017) posit that an excessive reliance on Manipulatives, to the exclusion of other teaching strategies, is unlikely to be conducive to the development of abstract concepts among students. In fact, such an approach may, paradoxically, dissuade students from attempting to master complex, abstract subject matter.

In agreement with the perspectives of Vang (2017) and Furner et al., (2017), the researcher believes that it is important for teachers to exercise caution in the appropriate application of Manipulatives in their pedagogical approaches. Emphasis should be placed on facilitating the establishment of a clear relationship

between the practical use of Manipulatives and their application in the world of abstract Mathematical symbols. Another crucial consideration is to help learners avoid the development of a dichotomous view of Mathematics, where they would hold the perception that the subject comprises of two independent realms - one reliant on Manipulatives and the other based on symbolic representations (Maboya et al., 2020).

2.7 TEACHER'S KNOWLEDGE AND BELIEFS ON MANIPULATIVES USE

“In studies where the use of Manipulatives resulted in unfavourable outcomes, plausible contributing factors included teachers' lack of knowledge on the tool's usage” - Quigley, 2021.

Contrary to common opinion, Manipulatives are not a panacea for teaching difficulties in the Mathematics discipline. Learners' minds may become confused if teachers do not guide them in the right direction when using Manipulatives. As an illustration, Day and Hurrell (2017) highlighted pupils who said that a fraction was "a piece of pie to eat" because fractions were usually represented by circular diagrams. Learners may thus be unable to make the connection between the tangible illustration and the being taught abstract concept. Such a situation serves as a reminder for the need for teachers to be knowledgeable about the best ways to use Manipulatives in the classroom. The simple fact that they are there does not guarantee success.

This is strengthened by Maboya et al., (2020), who wrote that the pedagogical effectiveness of a Manipulatives is not inherent in the physical object itself, but rather relies on the teacher's expertise and ability to facilitate learners in establishing relationships and comprehending the correlation between the manipulated objects and the theoretical construct under study. Therefore, the above scenario suggests that the level of teacher knowledge could potentially contribute to the success or failure in learners' ability to make connections between abstract Mathematical ideas and concrete concepts. Therefore, an emphasis

should be placed that teachers receive development and training on how to use Manipulatives, but they must also acquire guidance on its appropriate timing.

Additionally, Flores and Milton (2020) research uncovered that teachers employed pedagogical techniques that proved challenging for students to comprehend, resulting in an inability to grasp complex Mathematical concepts. The findings of the investigation further unveiled a prevailing notion among the participants that their teachers lacked the competence required to proficiently teach Mathematics. Thus, to effectively instruct students in the subject of Mathematics using Manipulatives, it is essential for teachers to assume roles as knowledgeable leaders and facilitators. In the realm of education, teachers need to impart knowledge in a clear and engaging approach, ideally facilitated through the utilisation of multiple audio-visual aids (Jameel and Ali, 2016:133).

Finally, teachers should refrain from holding a mistaken notion that the use of Manipulatives simplifies their work. This belief is misplaced since Manipulatives, when improperly used or insufficiently guided by the teacher, may instil confusion for learners. This inevitably would generate additional workload for the teacher to rectify these false impressions and/or fix any misunderstandings that have developed among the learners. Further research studies into whether South African teachers are skilled and competent enough to employ Manipulatives in the classroom should be conducted.

2.8 CHALLENGES TEACHERS FACE

Upon conducting thorough research into the challenges that teachers encounter when using Manipulatives within the classroom setting, the researcher discovered that only a sparse amount of scholarly literature had been dedicated to examining these challenges. Furthermore, the task of unearthing such challenges in the South African context was not easy. They did not initially anticipate such an outcome and it served as a noteworthy finding within the field of education that more research that examines the challenges that teachers face in their specific contexts needs to be conducted.

Numerous scholarly articles have delved into the advantages of Manipulatives and their effective implementation in the classroom; however, scant attention has been paid to the contextual challenges confronting teachers. Therefore, the researcher decided to locate literature that addressed the trials that teachers face within the realm of Mathematics instruction and establish correlations between these challenges and the efficacious implementation of Manipulatives. According to research by Camacho and Parham (2019), the attitudes and beliefs of teachers largely influence their selection of teaching strategies. Regrettably, some of these decisions are stimulated by the contextual factors with which they are confronted. Camacho and Parham (2019) revealed that some of these contextual factors can be noted as:

- a) Insufficient access to educational materials, inadequate budget allocation towards Manipulatives
- b) inadequate support from administrative entities,
- c) an overwhelming burden of classroom responsibilities.
- d) the need to cover an extensive scope of curriculum, limited classroom time, and the persistent demand for standardised testing creates impediments that discourage teachers from using Manipulatives.

Furthermore, according to Berkseth (2013), teachers assert that their busy schedules and heavy workloads preclude them from staying abreast of the most recent academic research in their respective disciplines. Consequently, they may unwittingly overlook valuable insights and perspectives that could augment their pedagogical approaches and improve their instructional strategies. More recently, a scholarly article authored by Elize du Plessis (2020), which was designed to comprehend the obstacles faced by teachers in South African schools, identified several contributory factors that impede effective instruction in the classroom. The initial predicament cited during the data collection sessions was that of excessive workloads. The participants conveyed that the content of the CAPS policy is replete with information and the allocated time is not adequate to thoroughly address the tasks involved (Du Plessis, 2020:74). Such an observation indicates

that teachers might be under time constraints and potentially perceive Manipulatives as inefficacious tools that impede instruction, rather than facilitating student learning.

Moreover, lack of resources emerged as a prominent issue articulated by the participants, wherein they voiced concerns about the necessity of acquiring adequate resources to ensure proper implementation of the Curriculum and Assessment Policy Statements (CAPS) framework. A fellow teacher subsequently expressed that the CAPS document was not formulated with consideration for the unique circumstances present within South Africa (Du Plessis, 2020:76). These obstacles present challenges for teachers to proficiently execute Manipulatives activities. As a teacher themselves, the researcher has further duly experienced that the issue of overcrowding poses significant challenges in managing learners' behaviour during Manipulatives-based activities. It is difficult to monitor the progress of each child, and to enforce discipline therefore, learners exhibit playful conduct due to the stimulation of the concrete objects.

2.9 THEORETICAL FRAMEWORK

2.9.1 Introduction

Lev Vygotsky's (1978) Sociocultural Learning Theory has formed the basis of a significant amount of research and theoretical frameworks in cognitive development. His sociocultural theory was particularly notable for asserting that social interaction shapes human development and that learners pick up cultural norms, attitudes, and cognitive development through cooperative conversations with people who have more knowledge about their society (the "More Knowledgeable Other") (Vygotsky, 1978).

While Piaget's theory contends that learners' development must first take place before they learn anything, Vygotsky believes that "human learning presupposes a specific social nature and a process by which learners grow into the intellectual life of those around them" (Vygotsky, 1978:88). His sociocultural theory concluded that social connections within the family and knowledgeable community members

are crucial for a child's acquisition of socially relevant behaviours and cognitive processes. In this situation, it is important to identify and understand that adult or peer figures' intervention plays a crucial part in supporting the entire process of such development.

Considering the above, the researcher attempted to establish a correlation between two conceptual constructs evident in Vygotsky's framework, and subsequently, related them to the way Manipulatives ought to be employed within the classroom.

2.9.2 Social interaction

“Collaborative learning has as its main feature a structure that allows for student talk: students are supposed to talk with each other....and it is in this talking that much of the learning occurs” (Golub, 1988).

Language and culture serve as the frames through which people see, share, and comprehend the world, according to Vygotsky's sociocultural theory. Language and culture are crucial for a person's intellectual growth as well as their worldview (Akpan et al., 2020). This suggests that concepts are first expressed through language and then understood through individual experience and social interactions within a specific cultural context. Knowledge is therefore not only socially produced but also co-constructed because a group of people must share a common linguistic and cultural background in order to form cognitive frameworks (Hover and Dicks, 2017). Thus, according to Vygotsky (1976), students may complete any learning assignment, regardless of how difficult it may be, if they are assisted by an adult or collaborate with others. Moreover, according to Moyer (2001), the act of conversation is a crucial element of Manipulatives use and is regarded as essential to the latter's success. This was supported by Moch (2001), who claimed that by simply relegating the use of Manipulatives to just 18 hours over the course of a seven-week period resulted in an average rise of 10% in test results.

This was partly because learners were constantly offered chances to participate in group conversations despite the use of Manipulatives. This demonstrates that it is important to incorporate writing, group and pair discussions, and Manipulatives into Mathematics lessons. It appears that despite the use of Manipulatives in the classroom, research suggests that language is important in promoting the acquisition of an abstract knowledge of any topic. Furthermore, in Vygotsky's view learners acquire knowledge and abilities more effectively when placed inside a social framework. As a result, social interaction is crucial for learning in a classroom setting since it encourages a collaborative teaching style therefore, a key piece of advice for a Mathematics teacher that incorporates Manipulatives is to make the students active participants in the learning process by including activities that support a student-centered approach (Mcleod, 2020). This can be done by creating activities that do not require the teacher to be in the front of the class all the time.

Additionally, it is advised that teachers prioritise inquiry using an interrogative pedagogy strategy in which the teacher asks the students more questions than they respond to as they manipulate the objects. Incorporating educational games and activities that inspire and challenge learners in their zone of proximal development is also a good idea (Daneshfar and Moharami, 2018). Similarly, Mutekwe (2018) advises that teachers incorporate group tasks according to their degree of difficulty, rather than solo work, to improve students' learning experiences. The use of entertaining and enjoyable tasks is a proven way to encourage social connection (Mutekwe, 2018).

2.9.3 Zone of Proximal Development and Scaffolding

Vygotsky's 1978 study presented in "Mind in Society: The Development of Higher Psychological Processes" delves into the development of psychological processes at a higher level. Vygotsky spoke of the Zone of Proximal Development and defined it as "the distance between the actual development level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance or in collaboration with more capable peer" (Vygotsky, 1978:86). In other words, Vygotsky explained the Zone

of Proximal Development (ZPD) as the present or factual state of the learner's development, coupled with the ensuing level that can be successfully achieved with the aid of intermediary semiotic and environmental resources such as Manipulatives, as well as the assistance of proficient adult or peer facilitators (Mutekwe, 2018).

Similarly, Tabler, (2018) writes that the main goal of education from a Vygotskian perspective is to support students within their individual zones of proximal development (ZPDs) by offering engaging and culturally significant learning and problem-solving activities that are above their individual levels of proficiency, necessitating collaboration with either a more skilled peer or a teacher/adult for task completion.

It is thought that doing a task cooperatively may increase a child's ability to carry out the same work independently in the future. The individual's Zone of Proximal Development in relation to the activity is anticipated to increase through this interactive process. Thereafter, to accommodate the learner's newly discovered zone of proximal development, this procedure is repeated at a higher level of task complexity (Eun, 2019). Figure 1 illustrates how this idea is illustrated.

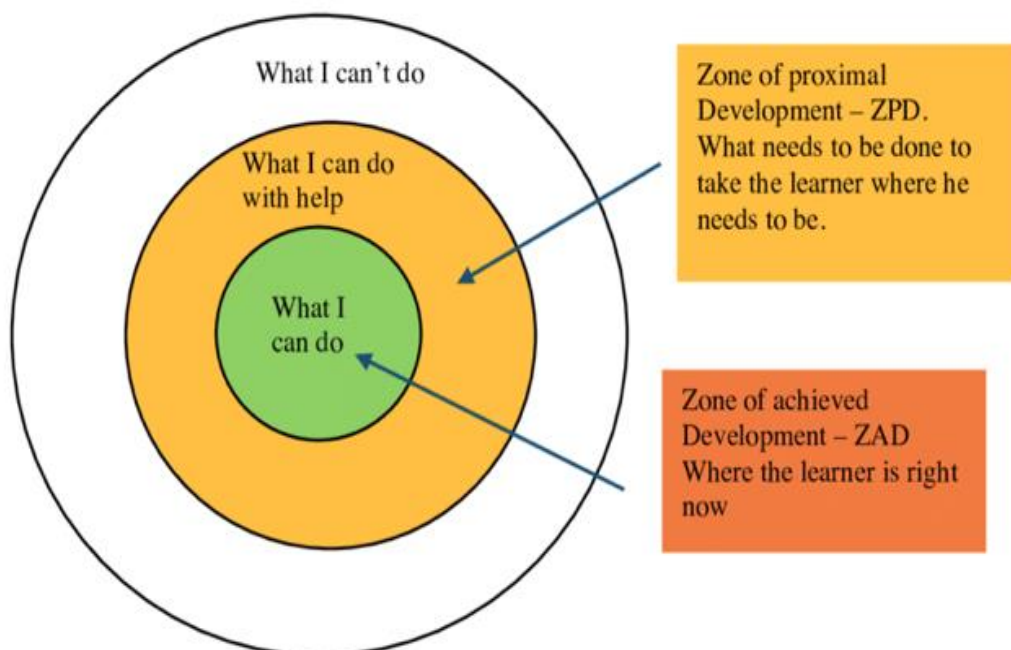


Figure 1: Zone of Proximal Development (Knowles, 2020)

To help learners reach this level of independence, Vygotsky used the term 'Scaffolding.' Scaffolding was initially used as a metaphor to represent a specific kind of aid used to facilitate student learning (Kurt, 2020). According to Puntambekar (2021), scaffolding is any sort of assistance given by a teacher or another student to a student to help them bridge the gap between their present abilities and the desired outcome. One should scaffold, or support, the pupil while they learn the Mathematics activity at hand rather than giving them clear instructions. Manipulatives are also one type of tool that a teacher could employ when instructing using scaffolding. Therefore, the Mathematics exercises may become increasingly difficult as the student learns more and reaches their potential level of cognitive growth. Additionally, while peer collaboration and scaffolding are encouraged, they should not be overdone as this can occasionally lead to stagnant progress (Mutekwe, 2018).

2.10 CONCLUSION

There were two major sections to the chapter. The initial section focused on a review of relevant literature, particularly those pertaining to the use of Manipulatives as a method of Mathematics instruction. The review was concerned with teachers' experiences and beliefs, even if it also considered other factors linked to this topic. This was partly because of their potential impact on teachers' experiences; as a result, it was essential to broaden the examination of the literature to account for the diversity of the teachers' experiences with the use of Manipulatives in the classroom.

The theoretical framework was discussed in the second portion of the chapter, when an effort was made to connect Vygotsky's ZPD with Manipulatives as an approach for teaching Mathematics in Grade 1. The theory was suitable for the study because it is flexible enough for teachers to use in their classrooms. The research design and methodologies that were utilised to investigate the earlier

indicated research objectives in chapter one is covered in the next section of the study.

CHAPTER 3: RESEARCH DESIGN AND METHODOLOGY

3.1 INTRODUCTION

The preceding chapter presented a comprehensive review of the relevant literature on Manipulatives and established the theoretical framework applied in the study. By using the Socio-Cultural theory, the researcher was able to better understand how teachers can best use Manipulatives in the classroom to improve Mathematics education for Grade 1 learners. In this chapter, the study's design and methodology are described. To achieve the research aims, which include examining the application of Manipulatives in Grade 1 Mathematics instruction by teachers, it was essential for the researcher to do a comprehensive observation of teachers' instructional practises which include Manipulatives.

An extensive explanation of the research methodology, paradigm, and design used in this study opens the chapter. In addition, the data generation plan, the sampling procedure, and the data analysis method were discussed. The data was collected through observations and semi-structured interviews carried out with a sample of five Grade 1 teachers. Ethical and reliability considerations for the study were also covered here.

3.2 RESEARCH APPROACH

This study used a qualitative research approach. Tenny and Brannan (2022) assert that qualitative research is an approach that facilitates in-depth exploration of individuals' experiences through the use of specialised research instruments, including interviews and observations. By listening to and learning from participants, qualitative research helps researchers pinpoint problems and gain insight into how people understand and make sense of the world around them (Mcleod, 2023).

A researcher must be flexible, open-minded, inquisitive, sympathetic, and able to hear individuals relate their stories to recognise these problems (Busetto, Wick and Gumbinger, 2020). Furthermore, to ascertain how an individual's experience

and behaviour are influenced by their life circumstances, qualitative researchers observe people in their natural environments (Mcleod, 2023).

A qualitative study necessitates a well-defined research question as its foundation. The research must involve an organised observation, categorisation, comparison, and evaluation of data. This process is crucial for determining an outcome that provides valuable and trustworthy new information (Cohen, Manion and Morrison, 2018). The following key research questions served as the foundation for this study:

- What kind of Manipulatives are teachers using when teaching Mathematics?
- How do grade 1 teachers teach Mathematics with Manipulatives?
- What challenges are teachers facing when teaching using Manipulatives?

The objective of this study was to investigate the extent to which Grade 1 teachers are capable of fostering Mathematical knowledge among learners by employing Manipulatives within the classroom. It looked at the experiences and opinions of the participants, therefore using a qualitative approach was appropriate. To address the difficulties associated with fabricating data and misinterpreting participant responses, the researcher diligently recorded the verbatim responses of the participants to the interview questions. Moreover, comprehensive, and meticulous data were obtained through the collection of notes derived from classroom observations conducted with a group of five Grade 1 teachers (Hennik et al., 2020). Furthermore, a qualitative approach allowed the researcher to explore, comprehend, evaluate, and interpret Grade 1 teachers' perspectives on the use of Manipulatives for holistic development of learning.

3.3 RESEARCH PARADIGM

The term "research paradigm" is used to describe the overarching theoretical stance taken by a researcher. It provides a set of assumptions, norms, and values

that guide your decision-making throughout the research process (Khaldi, 2017). This qualitative study was based on the interpretive paradigm. As stated by Cohen et al. (2018), the goal of the interpretive paradigm is to "understand the subjective realm of human experiences." Furthermore, as discussed by Alharahsheh and Pius (2020), this paradigm considers how much weight people give to certain events and activities. Interpretivism aims to make sense of social phenomena and provide context for the individual's environment (Khaldi, 2017) therefore, the interpretivist design was appropriate for this study given its goal of understanding the social phenomena of Manipulatives use in Mathematics education in the classroom.

Furthermore, the purpose of interpretive research is to inquire into not just people's experiences but also their perspectives on those experiences. As Creswell (2021:21) stated, interpretivism looks to "Grasp how people in typical social contexts make sense of and account for the events, actions, and experiences that shape their lives". This paradigm further allowed the researcher to study how teachers present and explain Mathematical concepts with Manipulatives. As a bonus, it gave them the leeway to explore, make sense of, comprehend, and analyse the views of teachers on their understanding of Manipulatives in the classroom and how that had impacted positively or negatively on their teaching strategies.

3.4 DESIGN OF THE STUDY

A case study design was used for this study. According to Sileyew (2019), a research design helps the researcher grasp the foundational framework of the study. An extensive and in-depth analysis of a particular incident, situation, or organisational unit is required for case study research. Typically, a case study has a defined time and place (Burkholder, Cox, Crawford, Hitchcock, 2019). Case studies provide a comprehensive overview of a specific event and demonstrate how it fits into broader contexts, allowing readers to understand the case and draw their own conclusions more clearly. Some generalisations or transferability may

also be possible (Nikolopoulou, 2022) if the lessons learned in one example may be applied to others.

In a similar vein, Cohen et al. (2018) define the scope of a case study as a detailed examination of a present-day event within its natural environment. Although it may be difficult to create clear boundaries between a phenomena and its setting, a case study uses many data sources to support its claims (Yin, 2018:15). Although the case study method has its own drawbacks, such as its inability to analyse a large number of cases (Nikopoulou, 2022), the researcher decided to use it because they wanted to learn more about how Grade 1 teachers in the Motheo District used Manipulatives in their lessons. Furthermore, with a case study design, the focus is on quality rather than quantity of data to gain an exhaustive understanding of a phenomenon (Cohen et al., 2018). As a result, the researcher interviewed teachers of learners in grade 1 to obtain information about the social value they placed on using Manipulatives in the classroom and to observe how that has impacted on how they use concrete objects during a Mathematics lesson.

3.5 RESEARCH SAMPLING

Purposive sampling was used in this work to collect the most relevant data possible to answer the research questions, as recommended by Cohen et al. (2018). Sampling is defined as "the selection of a subset of a population to be studied in order to generalise findings about that population" (Turner, 2020:8). Purposive sampling, according to Frost (2022), consists of situations that are rich in information and from which the researcher can obtain significant data. Participation from the full population of interest is usually not possible in research projects. As a result, data collection is often conducted with a small sample size (Turner, 2020).

Moreover, in qualitative research studies, it is crucial for the researcher to determine participants with intimate knowledge of the research topic, along with those who are willing to speak about their beliefs, ideas, and lived experiences (Sandelowski, in Gill, 2020). Consequently, five (5) Grade 1 teachers were chosen

using purposive sampling to participate in semi-structured interviews where they discussed their opinions and experiences using Manipulatives. Furthermore, the selection of these five participants was based on their occupation as Grade 1 Mathematics teachers at public schools located in Bloemfontein.

3.6 STUDY SITE

Since this is a multisite study, it was imperative that the research site be clearly defined to help the reader understand the context. The present study was carried out in two primary schools located in the Motheo District, situated in Bloemfontein within the Free State Province (FS). The schools were assigned pseudonyms, namely Spiki Primary and Pentse Primary.

As a so-called Railway Camp School, Spiki Primary School was constructed in 1899. From 1912 onwards, it started to take on the current shape of an English school. The school is categorised as a quintile 5 school.

A Sesotho home language public school, Pentse Primary School was established in 1970. The school is categorised as a quintile 1 institution. When it comes to matters of School Governance, both of the schools rely on their respective School Governing Bodies (SGBs) and School Management Team (SMT) to make major decisions.

The architectural integrity of Spiki Primary School is effectively preserved, fostering an environment conducive to academic engagement. The school is in the urban suburbs of Bloemfontein. Its curriculum accommodates learners ranging from Grade R to Grade 7. It is equipped with four classrooms dedicated to Grade 1, each accommodating an average of 32 learners. Furthermore, it provides services tailored to Middle-Class African learners who live with employed parents or guardians capable of meeting the financial obligations associated with the school fees.

Pentse Primary School is situated inside the townships, which are surrounded by informal settlements and shacks adjacent to Rocklands, Bloemfontein. There is an average of 48 learners in each Grade 1 classroom. Pentse Primary School caters to a socioeconomically disadvantaged population, characterised by a significant prevalence of unemployment. A large proportion of the learners often hail from socioeconomically disadvantaged households, as a result of a high prevalence of parental unemployment and a notable number of learners being under the care of their grandmothers.

Despite this study not being comparative research, the inclusion of participants from both privileged and underprivileged Grade 1 schools facilitated a deeper comprehension of how teachers from different contexts use Manipulatives to teach Mathematics as well as to highlight the various challenges associated thereof.

High-quality programmes and services, as well as adequate allocation of personnel, resources, and support, were used by Silver (2021) to categorise schools as either privileged or disadvantaged. Teachers' ideas about play and the most efficient strategies to encourage it, given the available resources and support, are profoundly influenced by these variables. As a result, this study's schools were categorised according to the resources (Manipulatives) in their classrooms as well as the assistance that was provided to both teachers and learners.



Figure 2: Map of research site, Bloemfontein

The context in which the schools functioned was crucial to the study because it influenced the teachers' methods and the availability of Manipulatives materials. Deeper understanding of Grade 1 teachers' practices was made possible by this information without the need for a formal statistical comparison of the data (Hadebe-Ndlovu, 2016:106). Below, the researcher elaborates on the school's Quintiles of Contexts.

In South Africa, the term "quintile school" refers to a classification scheme that the Department of Basic Education uses to group schools according to the socioeconomic standing of the communities they serve (DBE, 2005). A statement by former Western Cape Minister, Donald Grant, explained that the primary objective of this system is to ensure equitable allocation of resources and provide access to high-quality education for learners hailing from disadvantaged socio-economic situations (Western Cape Education Department, 2013). Schools are categorised into quintiles, which consist of five distinct categories. Quintile 1 denotes schools that are economically disadvantaged, while quintile 5 represents schools that are the least disadvantaged (DBEE, 2005).

Quintile 5 (Urban) School: A quintile 5 school in South Africa refers to a school that falls within the highest quintile of the country's school ranking system (Ogbonnaya and Awuah, 2019). This system categorises schools based on socio-economic factors, such as the income level of the surrounding community and the resources available to the school. Quintile 5 schools are typically located in more affluent areas and are known for having better facilities, resources, and access to quality education compared to schools in lower quintiles as espoused by Ogbonnaya and Awuah (2019:106). As a result, quintile 5 schools tend to offer a wider range of extracurricular activities, advanced academic programmes, and state-of-the-art facilities. Students attending these schools often have access to the latest technology, well-stocked libraries, and specialised resources that enhance their educational experience. The quality of teaching is also typically higher in quintile 5 schools, with highly qualified and experienced teachers who are able to provide

personalised attention and support to their students (Pretorius and Klapwijk, 2016).

Quintile 1 (Township) School: In South Africa, the education system is divided into quintiles, with quintile 1 schools representing those in the most disadvantaged communities (Ogobannaya and Awuah, 2019). These schools often face numerous challenges, such as limited resources, overcrowded classrooms, and high dropout rates. Exploring the realities and opportunities within quintile 1 schools can shed light on the broader issues of educational inequality and the urgent need for equitable access to quality education for all South African learners.

By examining the specific challenges faced by quintile 1 schools in South Africa, we gain a deeper understanding of the systemic barriers that hinder educational progress in disadvantaged communities. Limited resources, for instance, encompass a wide range of deficiencies, including inadequate infrastructure, outdated teaching materials, and a lack of technological support (DBE, 2005). These shortcomings created an environment where learners struggled to engage with the curriculum and teachers are burdened with the task of overcoming these obstacles. Moreover, overcrowded classrooms exacerbate the difficulties faced by both students and teachers, as individualised attention became nearly impossible.

3.7 POPULATION

The study involved the participation of five Grade 1 teachers, three of them were from Spiki Primary and two from Pentse-Primary. The selection of participants was based on their occupation as Grade 1 teachers at each respective school, as well as their teaching experience beyond a duration of 2 years. Additionally, it was reassuring to find that they expressed a willingness to partake in the study. According to Cohen, Manion, and Morrison (2018), determining the appropriate sample size is not a straightforward task since it is contingent upon various factors such as the study's objectives, the characteristics of the population being examined, and the desired level of precision. Moreover, Ettikan et al. (2016), deliberate that sample sizes in qualitative research are typically small due to their

focus on information-rich situations that can be thoroughly explored. The table below presents the profiles of the five interviewees:

No.	Participant Code*	School	Gender	Number of years in service
1.	Spiki-Meyer	Spiki Primary	Female	12 years
2.	Spiki-Chimbi	Spiki Primary	Female	4 years
3.	Spiki-Evelyn	Spiki Primary	Female	8 years
4.	Pentse-Reed	Pentse Primary	Female	17 years
5.	Pentse-Lesedi	Pentse-Primary	Female	14 years

Table 4: Participant profiles

3.8 DATA GENERATION PROCESS

According to Priya (2020), many data generation techniques are typically employed in a case study. In this study, semi-structured interviews and observations were used to collect data. According to Cohen et al. (2018), it is imperative for qualitative research and data collection methods to exhibit flexibility and sensitivity towards the social context, while also being situated within the natural setting. Due to this rationale, the researcher deemed it imperative to visit the participants' workplace to collect the requisite data.

The following table is provided to illustrate the methodology employed for data collection:

Data Generation Plan: Questions to ask	A Data Generation Plan
Why was data collected?	To explore whether Grade 1 Mathematics teachers make use of Manipulatives. To observe whether teachers use effective strategies when working with Manipulatives. To understand any factors which may pose challenges for teachers during Mathematics instruction.

What was the research strategy	The research strategies used were semi-structured interviews and classroom observations.
Who (or what) was the source of data?	Five Grade 1 teachers.
How much of the data was collected?	Five Grade 1 teachers were interviewed and observed during Mathematics teaching.
How often was data collected?	Five Grade 1 teachers were observed while teaching Mathematics and interviewed over a period of two weeks.
How was data collected?	Semi-structured interviews and observations were used to generate data
Why did this plan prove to be the best strategy for answering your questions?	<p>Semi-structured interviews provided me with an opportunity to conduct interviews with participants and learn more about their perspectives on the use of Manipulatives in the classroom.</p> <p>Second, I was able to gather useful information about how participants use Manipulatives in the classroom by observing the physical teaching and learning environment. I also had the unique opportunity to witness each participant's challenges firsthand.</p>

Table 5: Data generation plan

3.9 INSTRUMENTS FOR DATA COLLECTION

Stage 1: Semi-structured Interviews

As discussed by Heath (2023), interviews are frequently used to glean information about individuals' backgrounds, perspectives, beliefs, and opinions. Additionally, Bearman (2019) claims that interviews are the most popular means of data collecting in qualitative studies. Bearman (2019) argues that interviews are a useful way to learn about how others think about the world, how they see it, and

how they interpret and explain it to themselves. According to Brinkmann (2014), interviews are frequently used as a means of gathering information from participants. Interviews are commonly used in qualitative research, but they require careful planning, strong interpersonal skills, and clear speech (Heath, 2023) to be successful. Doyle (2022) asserts that in a semi-structured interview, a prescribed list of questions is employed, albeit not adhered to with precision. The questions help the researcher to delve further and act as a guide. This document is referred to as an interview schedule.

The researcher decided to employ semi-structured interviews to gather relevant data on the use of Manipulatives in Mathematics instruction from five Grade 1 teachers. A comprehensive interview schedule was established to mitigate the risk of excluding crucial information throughout the interview process. Additionally, this approach provided the researcher with the opportunity to explore many aspects of teacher planning and teaching strategies while engaging Manipulatives as a teaching approach. Moreover, they were able to gather rich, in-depth data using semi-structured interviews and confirm that participants understood the questions by probing further.

The five Grade 1 teachers and the principals of Pentse Primary and Spiki Primary were informed of the purpose of the research study. Consequently, the researcher developed the interview schedule as a framework for data collection. Two sets of questions were included in the schedule: the first set asked about the teachers' opinions and experiences with using Manipulatives to teach Mathematics, as well as the difficulties they sometimes face. The focus of the second series of questions was on the role that teachers played in Manipulatives teaching and whether this resulted in the positive or negative uses of Manipulatives. There were additional questions on the interview schedule that required them to have knowledge of Manipulatives.

Accurate documentation of the interview content was made possible using voice recorders during the interviews. An interview can be preserved in its entirety for examination later by using a tape recorder (Yin, 2018). In addition, it removed the

researcher from the distraction of taking notes during the interview, which was their primary method of gathering data.

Stage 2: Observations

observation is a common method of gathering information, and it can be performed in a variety of ways (Cohen et al.,2017). The authors additionally assert that observation is a remarkably versatile method of data generation due to its ability to facilitate the collection of data pertaining to the physical setting, interactional setting, and programme setting. It is a qualitative research technique that can be applied to recording classroom interactions.

Qualitative observation involves the description of the traits or qualities of a phenomenon, without relying on quantitative measurements or statistics. Instead, the observation is predicated on the subjective perception of the observer regarding what they hear, taste, smell, feel, or see (George, 2023). Observations were the method of choice since they enabled the researcher to gain personal knowledge of how Grade 1 teachers truly employ Manipulatives in their classrooms. Observing teachers in the classroom gave them insight into the natural social interactions that take place during teaching. In addition, George (2023), provides support for this idea by arguing that people's behaviours can be inconsistent with their words. Therefore, observations validated what actually took place in the classroom context during the use of Manipulatives for Mathematical learning.

The aim of this study was to observe the Grade 1 learning settings and activities therefore, the researcher visited the chosen schools and specifically focused on five classrooms. They were able to avoid relying on secondary sources and instead get data from personal experience. Furthermore, the research involved the observation of both spoken and nonverbal interactions between the teachers and students in the classroom. The researcher took note of the teaching strategies used, the content of the curriculum, the forms of assessment used, and the allocation of available resources.

Photo evidence of learners' work and additional materials for learner-teacher support (LTSM) were also captured. Images helped the researcher remember things that they had missed and provided a point of reference for interpreting the data. Each teacher was allocated 60-minute time windows for observations. The researcher was able to see the natural reality of Grade 1 classrooms and how teachers deployed Manipulatives to teach Mathematical concepts from the observations made during class.

3.10 MEASURES OF INSTRUMENTS' VALIDITY AND RELIABILITY AND PILOTING

The measurement of research quality involves the consideration of reliability and validity as key concepts (Cypress, 2017), as they show how precise a certain approach is in its measurement of a phenomenon. Validity refers to the accuracy of a measure, whereas reliability refers to the consistency of a measure (Middleton, 2019). The omission of reliability and validity considerations in research can result in many forms of research bias and significantly impact the overall quality of the study (Thakur & Chetty, 2020).

To determine whether interviews and observational methods would be more successful in gathering and analysing data for this specific study, the researcher conducted a pilot study. They worked with five Bloemfontein-based Grade 1 teachers who were chosen at random. Before the researcher even set foot in the field, the pilot study helped them prepare for unanticipated issues by showing them how to recognise and handle ethical and practical issues like inappropriate questions that could jeopardise the main study or violate participants' human rights.

As a result, the pilot study ensured validity and reliability as it enabled the researcher to refine the research questions and apply qualitative research by critically analysing whether the data provided from the piloting phase was relevant and sufficient to meet the objectives of this study. There was no use of the pilot test data in the primary data collecting and analysis.

To further strengthen the validity and reliability of the study, the researcher engaged a variety of sources and approaches for collection and analysis, hence employing triangulation and cross-validation techniques to corroborate their findings. Triangulation in research refers to the practice of applying a combination of diverse datasets, methodologies, theories, and/or researchers in order to effectively investigate and address a specific research inquiry (Carter, Lukosius, DiCenso, Blythe, & Neville, 2014; Patton, 2015; Delve, 2023).

This research technique can help one reduce the likelihood that any study biases will appear in your work and increase the validity and trustworthiness of your findings (Delve, 2023). In this study, the researcher implemented the approach known as methodological triangulation, which involves making use of a minimum of two distinct research methods to investigate the same research question (Valencia, 2022); and thus, the researcher incorporated two data sets consisting of semi-structured interviews conducted with teachers and observations in the classrooms. These data collection strategies aimed to investigate a variety of experiences and perceptions.

3.11 DATA COLLECTION PROCEDURES

After the completion of the pilot testing with three Grade 1 teachers, the researcher commenced the process of recruiting participants for the study. Having obtained ethical clearance from all relevant gatekeepers, they convened with the principals of the two schools to seek authorisation for conducting observations and interviews within their respective schools. The participants were duly advised on the research aims and objectives. Additionally, each teacher representing their respective school was furnished with comprehensive details regarding the ongoing research and was presented with consent forms. The researcher observed solely the Mathematics periods in each teacher's class for a total of 2 weeks. Following the teaching session, they successfully completed 30-minute interviews with the participants after school, with the explicit authorisation of both the principal and the participants involved.

The interviews conducted in this study were semi-structured in nature, consisting of open-ended questions. The researcher wanted to get a sense of the experience's teachers have with Manipulatives through their responses, and because the interview was semi-structured, participants could provide as much information as they went in-depth, and that they could follow up with additional questions that really got to the heart of the matter. The interview questions can be located in Appendix E. Following the completion of the interview process, the researcher proceeded to transcribe the interviews and thereafter engaged in a coding exercise to identify recurring themes that were prevalent in the literature study and had the potential to address my research objectives. A total of 24 codes were consistently identified within the dataset. The codes were further categorised, leading to the identification of five themes that will be examined in chapter four.

3.12 DATA ANALYSIS PROCEDURES

The primary objective of data analysis is to decipher and derive meaning from the information included within the data (Lowe, Norris, Farris, Babbage, 2018:193). Organizing data into categories and finding patterns and relationships among the categories is the main inductive process of qualitative data analysis state Busetto, Wick and Gumbinger (2020). Furthermore, Cohen, Manion, and Morrison (2018) argue that the analysis and presentation of data does not adhere to a singular or definitive approach, but rather should be guided by the principle of suitability for a certain goal.

The primary data gathered for this study consisted of audio recordings of interviews, photographs depicting the Manipulatives employed within the classroom environment, field notes taken during classroom observations, and records of the activities the learners did. Thereafter, the researcher identified codes, which meant reading the transcripts and observation notes. The research questions, data collection questions, observation guideline, the findings, and the analysis of pertinent literature all contributed to the discovery of these codes. During the coding process, the researcher used pens of varying colours to

distinguish between and classify similar pieces of content. Coding, as described by Elliot (2018), is the first stage of qualitative analysis and provides a foundation for the next steps. In addition, Elliot (2018) defines coding as the process of giving specific labels to different parts of a dataset.

After the data was coded, the researcher looked for common themes from the interviews with participants and the classroom observations. The common themes were taken into account for drawing conclusions. The researcher followed Braun and Clarke's (2006) six-step process for thematic analysis. They elaborated on how, rather than a linear process, these steps should be seen as recursive. The following are the steps involved in theme analysis (Braun & Clarke, 2006; 2012):

- Familiarising yourself with the data
- Generating initial codes
- Searching for themes
- Reviewing potential themes
- Defining and naming themes
- Producing the report

In alignment with the above steps, the researcher listened to the recording and reviewed the data several times. Following that, they proceeded to implement the coding phase, as prescribed by Braun and Clarke (2006). Throughout the analysis, patterns emerged, and codes were created. They moved on to the third stage, which was to search for repeating ideas. Codes and data were collected for each relevant topic (Braun & Clarke, 2006). The next step was to compare the themes to the coded extract for consistency (Braun and Clarke, 2006). The fifth step was to determine the theme's basic notion, which allowed for the identification and definition of topics (Braun and Clarke, 2006). The sixth and last stage, writing it all up, is discussed in detail in chapter four.



Figure 3: Final Themes

3.13 ETHICAL CONSIDERATIONS

It is imperative for qualitative researchers to uphold an ethical framework that prioritises respect for the individuals involved in the research process asserts Bhandari (2021). Ethics encompasses the set of principles and values that govern judgments on appropriateness or inappropriateness, as well as determinations of rightness or wrongness (Arifin, 2018). Hence, the researcher adhered to the ethical guidelines set forth by the university. They submitted applications for ethical clearances to the research office of the institution. The University of the Free State and Department of Basic Education provided ethical clearance approval for this study (see to Appendix A and B).

It stated that only participants who are experienced teachers with understanding of the research topic will have data collected from them. Participants in interviews were notified beforehand, and upon consenting to be interviewed, they received an informed consent letter. The interviews were scheduled to take place during non-school hours, at a time that was convenient for the participants.

Additionally, the teachers were made aware of their right to discontinue the interview at any moment and to withdraw entirely from the study. The participants were cognizant of the fact that their interviews would be captured by an electronic device and afterwards used for the purpose of data analysis. The Letter of Informed Consent draft is available for reference in Appendix D.

3.13.1 Participants' rights, informed consent, confidentiality

Prior to the face-to-face interview, the study's participants, consisting of five Grade 1 teachers, were provided with explicit notification that their identities, as well as that of their respective school, would remain confidential and would not be divulged in any section of the study. The researcher gave the participants a clear explanation of their right to withdraw from the interview at any moment if they felt unable to continue. As the study progressed, they realised how crucial it was to uphold the participants' rights. Prior to the data generating process, the participants were required to provide informed consent in writing (see to Appendix D).

In order to maintain precision in the documentation, a tape recorder was employed to verify correctness of the recorded information, while a camera was used to capture significant photographs. The inclusion of images in the study served as a valuable reference for interpreting the data and proved important in facilitating recollection during the data analysis process. However, before taking photographs, the researcher made sure to get permission and discuss its significance.

The participants were provided with an assurance that all data obtained during the study would be securely stored in the university storage and subsequently deleted after a period of five years.

3.14 CONCLUSION

This chapter provided a description of the study's approach, which is qualitative in nature, its interpretivist paradigm, and case study design. Purposive Sampling was

used to explore the experiences of Grade 1 teachers who used manipulatives in the classroom. Furthermore, the researcher elaborated on the data generation plan, and the steps taken during data analysis and how they arrived at the final themes. Subsequently, the study's limitations, ethical considerations, and guarantees of dependability were addressed. Chapter 4 will present the data analysis and findings about the use of manipulatives by Grade 1 teachers to effectively teach Mathematics.

CHAPTER 4: FINDINGS AND DISCUSSION

4.1 INTRODUCTION

The Research methods and design were described in detail in the previous chapter. The methods of data collection, including semi-structured interviews and field observations were outlined. The interview data was coded and then subjected to thematic analysis. The researcher discussed the study's findings in light of the research questions, which sought to understand Mathematics teachers' use of Manipulatives in the classroom, the kinds of Manipulatives they employ, and the difficulties they encounter when implementing this method of teaching.

This chapter presents and discusses the themes based on data gathered through interviews with five Grade 1 teachers at two primary schools and by observations of Grade 1 teachers in the classroom. The researcher analysed data from teacher interviews and classroom observations to find out if teachers had a firm grasp on the best ways to put Manipulatives to use in the classroom.

The findings are integrated with the discussions to provide an immediate interpretation of the results for clearer understanding for readers. Literature is also incorporated into the discussion results. The researcher uses Vygotsky's sociocultural theory as the framework to support the findings. In the discussion of the findings, the researcher provided verbatim quotations from the teachers. The following pseudonyms are used: Spiki Primary: Spiki-Lee, Spiki-Chimbi and Spiki-Evelyn; Pentse Primary: Pentse-Reed and Pentse-Lesedi. The names of the schools (Spiki and Pentse) are added as prefixes to the surnames of the participants to clearly establish which school the participants are from. Moreover, research participants are abbreviated as R.P. Finally, a chapter conclusion is presented.

4.1.1 Biographical characteristics of participants

Five Grade 1 teachers from two primary schools formed part of the participants of the study. Interviews and observations were conducted with them and below is a summary of the biographical characteristics and Manipulatives they used in their lessons. As indicated above, pseudonyms were used where the name of the school is a prefix to the name of the participant (Setoromo and Hadebe-Ndlovu, 2020) Below (Table 6) is a table which clearly describes the demographics of the participants in relation to the study.

Participant	Quintile	Gender	Teaching Experience	Manipulatives	Context
R.P 1. Spiki-Lee	5	Female	12 years	Study Unifix Cubes	Urban
R.P 2 Spiki-Chimbi	5	Female	4 years	Sweets	Urban
R.P 3 Spiki-Evelyn	5	Female	8 years	Six Bricks	Urban
R.P 4 Pentse-Reed	1	Female	17 years	Fruits Number Board Unifix Cubes	Township
R.P 5 Pentse-Lesedi	1	Female	14 years	Abacus	Township

Table 6: Participant demographics

4.2 THEME 1: DEFINING MANIPULATIVES

It was crucial to verify the participants' grasp of the idea of Manipulatives before engaging in an in-depth analysis relating to the effective use of Manipulatives in Grade 1 classrooms. Insufficient familiarity with the concept of Manipulatives among the participants would have impeded the advancement of this study.

4.2.1 3D Concrete objects

When the researcher engaged the participants to give their own definitions of what Manipulatives are, some of the responses were as follows:

R.P 1, Spiki-Lee, asserted the following:

"Manipulatives are concrete objects for teaching that help learners to visually and physically experience a Mathematics concept such as plus and minus. In my classroom, I use different materials such as stones and abacus."

R.P 2, Spiki-Chimbi explained:

"My understanding of Manipulatives is that it is any object that the learners are able to touch and use to count with."

While the participants went well beyond defining Manipulatives in accordance with existing research (Moyer, 2001; Swan & Marshall, 2010; Charles-Cole, 2020; Delport, 2021), they did not address a critical component of Manipulatives as per this research which is namely their movable nature. The absence of emphasis on the requirement for Manipulatives to be movable may create a misleading perception that any tactile object, even non-movable items such as windows, can be categorised as Manipulatives which would not be appropriate for this study. Hence, even a static rectangular configuration such as an abacus, can be classified as a Manipulatives because of the presence of movable small square components that facilitate counting for learners.

Fortunately, despite the lack of thorough clarity from the participants during the interviews, they all used Manipulatives that the learners could move, such as six bricks and unifix cubes in their lessons. Even in the township school (Pentse Primary), where socioeconomic conditions may have contributed to the notion that teachers would be not well-equipped to use Manipulatives, this was not the case. Furthermore, R.P 2 Spiki-Chimbi, was accurate in her assertion that Manipulatives encompass objects that learners may engage physically without necessarily emphasising on colour which unfortunately, according to literature, is a popular idea amongst teachers that Manipulatives must possess bright colours. Lange (2021:8) argues that objects with a high level of perceptual complexity, such as

various colours and lines, hinder learners' counting skills and act as diversions for learners.

This observation aligns with the conclusions drawn by Carbonneau et al. (2013), who observed that certain learners may perceive Manipulatives as disrupting, particularly when they bear a strong resemblance to everyday things. This form of stimulus impedes learners' ability to actively focus on and engage in the learning process. Nonetheless, based on observations made during the Mathematics lessons, the researcher was satisfied concluded that all participants had a basic understanding of what Manipulatives were as defined in scholarly literature (Papadopoulou, 2020; Sum Kwing Cheung et al., 2023), and that they successfully used objects that the learners could manipulate and touch. The appropriateness of the Manipulatives used during lessons will be subject to a more rigorous analysis in Themes 2 and 3 of the study.

4.3 THEME 2: EXPLORING TEACHERS' PERSPECTIVES ON MANIPULATIVES IN THE CLASSROOM

To better grasp the participants' perspectives and feelings towards Manipulatives in the classroom, the researcher started theme 2 with an examination of their attitudes and perspectives towards Manipulatives. The experiences of the participants mentioned below are inherently subjective and are shaped by their own perspectives and judgments; ultimately affecting the specific practices they choose to apply.

It is important to emphasise that participants' experiences and beliefs mostly refer to their teaching behaviours and attitudes, rather than their research expertise. Thus, the researcher thoroughly analysed their characteristics, the information they presented, and the manner in which they expressed themselves. The researcher divided the participants beliefs and views of Manipulatives for Mathematics teaching into subthemes based on the final codes, namely: (a) Participants' beliefs that Manipulatives provide learners with a deeper conceptual understanding, (b) that Manipulatives enable participants to integrate more than

one Mathematics topic into their lessons, (c) and that Manipulatives can be used as intervention tools. The following excerpts comprise of participants' replies regarding the significance of Manipulatives in fostering learners' comprehension of Mathematical concepts.

4.3.1 Deeper conceptual understanding

R.P 1 Spiki-Lee: *“Mathematics starts with numbers. Learners should be able to understand one-to-one correspondence, so when I use counters, for example, they are able to represent the number five physically and visually.”*

R.P 2 Spiki-Chimbi: *“When the little ones come into the classroom in term 1, they are still unclear on for example, “more and less” so I give them counters so that they can make groups that are bigger and smaller, and from there they would be able to understand that 10 is more than 6 by literally seeing it too.”*

R.P 3 Spiki-Evelyn: *“I really enjoy using clay and so do my grade learners. If I am teaching shapes, I say to the learners: “roll your play dough and make it round like a stop sign. The learners then traced around the circular dough to get the feel of a circle. I will do the same for all the other shapes.”*

After considering the participants' individual viewpoints regarding Manipulatives, the researcher discovered that the three participants, Spiki-Lee, Spiki-Chimbi, and Spiki-Evelyn, who work in a quintile 1 school located in the urban Bloemfontein area were in favour of using Manipulatives in their Mathematics classes and all agreed that Manipulatives give learners the chance to connect Mathematical concepts and symbols, which improves their comprehension.

The responses of the participants suggest that teachers believe that Manipulatives can be important tools for encouraging students to think and reason more meaningfully. Manipulatives such as pattern blocks, tiles, and cubes can help learners acquire solid integrated grasps of Mathematical concepts by providing them with tangible methods to compare and work with quantities as the interviews suggested. Similarly, Odum (2022:788) notes that Manipulatives materials give

learners the opportunity to create their own cognitive models for abstract Mathematical concepts and procedures, in addition to giving them a common language to express these models to peers and teachers. Furthermore, manipulating materials can directly support cognitive processes (Liggett, 2017).

Additionally, during the observation of the lessons at both schools, manipulatives materials increased the learners' curiosity and enjoyment of Mathematics. Learners had a heightened level of interest in the field of Mathematics, and in the end, which according to Florez et al., 2017, should result in higher marks (Florez et al., 2017), as was emphasised by R.P 3 Spiki-Evelyn.

R.P 4 Pentse-Reed, from a quintile 1 school, had a similar positive belief that Manipulatives are crucial in bringing about the principles of constructivism in the classroom. She reiterated that:

"The CAPS curriculum and Annual Teaching Plans (ATP) contain many topics that learners need to grasp in grade 1; for example, when learners use unifix cubes to explore tens and units, they are better equipped to understand and engage with the associated steps of Expanded Notation at a later stage".

Will they all develop that deep conceptual understanding the researcher asked asked? *"No of course not, but definitely the majority of the class would have."* she firmly responded.

Similarly, R.P 2, Spiki-Chimbi added that:

"When learners physically touch and move objects around, their understanding of concepts, such as fractions, becomes clearer. Division and multiplication generally take time for the learners to catch, but at least the Manipulatives help them to understand better."

This was clearly apparent during the observation of her lesson on Grouping and Sharing. R.P 2, Spiki-Chimbi, distributed a selection of sweets, including Smarties and Astros, to her learners. Following this, she instructed them to categorise the

sweets according to their individual colours or, alternatively, to distribute the candies among, for example, three as shown in Figure 4. The learners effectively demonstrated their knowledge of grouping and sharing and could understand that sharing is the same as halving and grouping is related to multiplication.



Figure 4: Lesson on grouping and sharing in RP. 2 Spiki-Evelyn classroom

The similarity between the participants' perspectives on the effectiveness of Manipulatives in introducing Mathematical topics and the Curriculum and Assessment Policy Statements (CAPS) is evident. The CAPS curriculum highlights the value of hands-on experiences for young learners, enabling them to engage with Mathematical concepts in a concrete manner, and clearly states that teachers ought to use Manipulatives such as counting bears, bricks, or beads as teaching tools to facilitate the comprehension of fundamental Mathematical concepts, including counting, addition, subtraction, and patterns (CAPS, 2012) which the participants (R.P 1, R.P 2, R.P 3, R.P 4) all related to. Furthermore, it was reassuring to learn that despite challenges, such as overcrowding and a lack of resources, R.P 4 Pentse-Reed still believed that Manipulatives had a place in the Mathematics classroom, even when used during the introductory phase of teaching a concept.

4.3.2 Integrating Mathematics topics

R.P 3 Spiki-Evelyn explained that Manipulatives enable teachers to exhibit flexibility and effectively teach multiple Mathematical ideas simultaneously. When she was asked to engage the researcher further on that statement, she said:

“The CAPS document has five learning areas which are Numbers, Operations and Relationships, Patterns, Space and Shape, Measurement and Data Handling. So you can only imagine the amount of work it takes to get through the curriculum however, whenever I use Manipulatives, I tend to incorporate all the content areas and kill many birds with one stone.”

This was precisely what she did during her classroom observations using six bricks. She distributed six bricks to the learners. Initially, she asked them to count how many bricks they currently had and how many more they would have if they divided the blocks in half (Numbers, Operations and Relationships). Next, she drew the learners' attention to colours and had each of them point to and identify the colour of each of the six bricks before instructing them to create patterns (Patterns). Finally, R.P 3 Spiki-Evelyn directed the learners to construct different two-dimensional shapes using blocks (Space and Shape). In only a span of ten minutes, the participant covered the fundamental principles related to the various content areas of the CAPS curriculum (CAPS, 2012:11).

Ultimately, R.P 3 Spiki-Evelyn and R.P 1 Spiki-Lee were the only participants (33%) who combined the different Mathematics topics into their Manipulatives lessons and the advantageous nature of integrating different topics into a single period lead the research to believe that the Department of Education should consider offering additional workshops and training sessions to teachers on how to make best use of Manipulatives within the CAPS curriculum. This would enable teachers to optimise their time management, as exemplified by the observed lessons of R.P 3 Spiki-Evelyn. In addition, it will potentially challenge the perspectives of certain teachers who believe that Manipulatives are a waste of instructional time, particularly those working in resource-limited environments. The Department of Basic Education confirms this view by asserting that subject integration is encouraged, because learners should view Mathematics as a holistic discipline (CAPS, 2011).

Furthermore, the LEGO Foundation, through its Care for Education initiative, has initiated efforts to provide training and guidance to teachers on effectively

integrating the six bricks into the curriculum through many creative approaches. They offer training and instructional resources to learners, schools, and organisations that require them (Matangira, 2022). This further exemplifies the efforts of the National Department of Education to promote the incorporation of Manipulatives into teachers' instructional practices.

4.3.3 Intervention tools

In the following discussion, the researcher presents an account of the interview findings and observations that delve into the beliefs of the participants regarding the role of Manipulatives as intervention tools for confronting diverse classroom barriers. They conclude by relating Vygotsky's theory to the analysis of the results.

R.P 1 Spiki-Lee relayed:

“Teachers have the capacity to support students who experience challenges in understanding certain Mathematical topics such as ‘time’ by using Manipulatives. This measure guarantees that every child receives appropriate help to prevent them from being left behind.”

R.P 4 Pentse-Reed provided further clarification:

“Unfortunately, because of COVID19, there is an increasing number of learners who walk into Grade 1 without being able to represent the number eight using drawings for example. So, I literally need to take stones or even their pencils and let them count the number while pointing out to the pencils, and this helps learners understand number concepts. Remember, some of these learners did not even start in Grade R so it’s like I am working with a blank canvas so really the Manipulatives help those learners a lot.”

R.P 2 Spiki-Chimbi similarly asserted that:

“Minus is really not an easy concept for the learners. There are some who can use their fingers but to be honest, others need to literally see 6 counters and take away 3 for them to find the answer.”

The above excerpts provide an authentic portrayal of the support that Manipulatives offer to learners facing significant obstacles in learning Mathematics. A further benefit for the teachers is that at the end of the school year, when they are required to account to the School Management Team (SMT) on how they supported a child, they will be able to demonstrate that they did not simply leave the learner alone, but instead facilitated him/her by using Manipulatives, as was stated by R.P 5 Pentse-Lesedi: *“I mostly use Manipulatives to help the struggling learners because even at the end of the year when I have to account on how I assisted a child, I am able to state that I gave them concrete objects to work with.”*

In contrast, the three participants from Spiki Primary, where English serves as the medium of instruction, expressed that several learners are being taught in a language that is not their native tongue, predominantly Sesotho and Setswana-speaking learners. As a result, Manipulatives are employed to assist learners in generating visual representations of Mathematical problems to arrive at a solution. In particular R.P 1 Spiki-Lee and R.P 2 Spiki-Chimbi are unable to translate into the dominant Sesotho/Setswana Home Languages of the learners and thus, Manipulatives function as a buffer to explain processes to the learners in a simplified manner.

This phenomenon can be likened to the practice of Code Switching; however, instead of employing language, it involves the use of objects. *“It’s like code-switching using objects...” R.P 2 Spiki-Chimbi exclaimed.*

R.P 1 Spiki-Lee supported this statement by further elaborating:

“When learners who do not understand English properly get to represent a word sum physically, they are able to find the answer without feeling anxious.”

At Spiki Primary and Pentse Primary, it was evident that each learner has distinct characteristics, as they originate from diverse South African backgrounds, exhibit variable degrees of comprehension, and possess individualised strengths and limitations; and although the notion of addressing the unique needs of each

student may appear challenging, the implementation of differentiation strategies, such as taking advantage of Manipulatives, provides a systematic and flexible teaching method, that guarantees equal opportunities for the success for all learners.

In addition, the CAPS curriculum acknowledges the significance of addressing individual needs; therefore, differentiation aligns perfectly with the CAPS ethos, which emphasises skills, content, and values in ways that are accessible and meaningful to all students (CAPS, 2013). Similarly, it has been argued that while certain learners may have the ability to approach problems logically, they often encounter difficulties in abstract thinking (McLeod, 2020). Therefore, Manipulatives provide a highly effective means to bridge this cognitive divide. Grade 1 learners can engage with many materials to generate tangible experiences that facilitate the development of abstract thinking skills.

Nevertheless, teachers must exercise caution when using Manipulatives as intervention tools, as there is the potential drawback of excessive dependence on these objects among learners with greater delays. In turn, learners may encounter challenges when attempting to apply their knowledge to unfamiliar situations, alternative assessment formats, or abstract concepts such as algebraic expressions. As was noticed in some of the lessons, Manipulatives may divert students' attention away from learning in favour of having fun or make learning more difficult. The researcher observed this reliance on Manipulatives in R. P 5 Pentse-Lesedi's lesson. She provided unifix cubes to a struggling learner to assist him in completing an addition and subtraction worksheet. Certainly, the Manipulatives helped the learner solve the problems and find answers, but he remained silent when the participant approached him to ask how he calculated the sum of $8-4$. It became apparent that the use of Manipulatives did not contribute to the development of academic language or facilitate verbal explanation. The learner was able to construct a model of how they solved the problem but struggled when asked to explain the concept.

Herein lies the relevance of Vygotsky's teachings regarding the significance of language use. It is recommended that teachers continue to offer auditory prompts and foster a practice in which learners articulate each step while engaging with items to arrive at a solution. During social interaction, a more capable individual may assist a learner in advancing to a higher level with the knowledge and skills they already possess using language and other supportive conditions.

Manipulatives are not silver bullets that solve all problems; rather, they should be used in conjunction with other instructional strategies for maximal effectiveness. In contrast, R.P 5 Pentse-Lesedi stated that Manipulatives assist learners, particularly those with a specific learning barrier; however, she believed that Manipulatives were not only a source of distraction but also hindered learners' ability to engage in abstract thought. This perspective diverges significantly from that of the other participants.

She asserts: *“Just imagine in a test, there are some learners who are so used to concrete objects that they no longer want to think. And it takes extremely long to complete their tasks, so I really do not use them too much.”*

Therefore, it is evident from the above that even if teachers feel that giving Manipulatives to learners who are conceptually delayed will help them succeed, they should still undergo in-service training from the Department of Education subject specialists to learn how to use Manipulatives as an additional resource. Ideally, this task should be executed within the immediate school context by employing objects readily accessible within the classroom setting. Lastly, learners should be given time, even if it is only 15 minutes per day, to engage in free Manipulatives play so that they can become more comfortable with the objects and enter their own phases of discovery and learning (Schumacher, 2021).

In closing, the results from Theme 2 were diverse. While it was theoretically believed by all participants that Manipulatives aid in conceptual learning, only 83% expressed the perspective that they are highly advantageous in many ways. One participant shared that Manipulatives have the potential to serve as a source of

distraction for learners. However, it was unanimously agreed upon by all participants that Manipulatives are indeed beneficial for learners encountering difficulties in Mathematics, since they provide a tangible means of engaging with inherently abstract concepts within the subject area of Mathematics.

4.4 THEME 3: TYPES OF MANIPULATIVES

As mentioned in the literature review, Manipulatives can be classified into two main categories: informal and formal. In the following discussion, the researcher examines the formal and informal Manipulatives employed by participants in the classroom, with the aim of finding an answer to the first research question on the kinds of Manipulatives teachers make use of.

4.4.1 Informal Manipulatives

“Well, Manipulatives can be anything really... I even go to the extent of using small stones if I have to” elaborated R.P 4 Pentse-Reed. During the observation, it was clear that the participant had displayed other physical objects in addition to the six bricks used in the lesson, including packets of lollipop sticks in a rainbow of colours and a wide variety of clothing pegs, which are both of a more informal nature.

When asked about the different types of Manipulatives seen in the classroom, R.P 4 Pentse-Reed said:

“I use the lollipop sticks for counting so that the learners can actually see the quantity of five or ten. Sometimes, I let them build 2D shapes by using sticks. They do not really come in many bright colours, but the learners still enjoy moving them around and building. The faster learners don't care much for them during writing activities because they don't need them, but they do really help the learners who are delayed.”

Additionally, during the observation session of R.P 2 Spiki-Chimbi, she purchased packages of Astro and Smartie sweets, which were small in size, colourful, and multi-shaped. She began by instructing learners to classify their sweets based on

their respective colours. Learners eventually formed groups of pink, purple, yellow, blue, and green sweets. Following this, she would provide instructions for the learners to place a yellow smartie on the table and position a green smartie next to it, thereby establishing a pattern for them to carry out independently. The bright characteristics of the sweets, which she used as a type of informal Manipulatives, allowed her to demonstrate versatility in her class and teach learners multiple Mathematical concepts.

Moreover, R.P 4 Pentse-Reed and R.P 5 Pentse-Lesedi demonstrated that despite the limited availability of formal Manipulatives due to the socioeconomic circumstances of their schools, they were still able to effectively employ alternative resources. This is attributable to their comprehension of Manipulatives and their functions. Taking this into account, R.P 4 Pentse-Reed had a lesson on patterns involving apples and oranges. The colours that were visible were orange, red, and green, allowing for the development of various patterns such as growth and repetition (Figure 5.) Finally, she had a collection of brightly coloured beverage bottle caps that were easy to manipulate.



Figure 5: Informal Manipulatives: Apples and pears in R.P 4 Pentse-Reed's classroom

A noteworthy observation was made in the classroom of R.P 1, Spiki-Lee, which proved to be intriguing. In this study, study is not deemed as a 3D concrete object; however, the participant requested the learners to cut strips of coloured study and assemble them into conjoined circles. The former 2D piece of study had now been transformed into a 3D chain of circles, which led to students uncovering shapes

and even measuring whose chain was longer and shorter, a topic covered in the CAPS curriculum (Measurement).

4.4.2 Formal Manipulatives

It was particularly intriguing to witness the wide array of formal Manipulatives that participants had at their disposal. The three participants from Spiki Primary: Spiki-Lee, Spiki-Chimbi, and Spiki-Evelyn had storage rooms within their respective classrooms. These storage rooms had a diverse assortment of Manipulatives tools, which were influenced by the Montessori educational approach.

R.P 3 Spiki-Evelyn explained:

“We are very fortunate that at the end of the year, the school principal asks us what we need in our classrooms, so we really do have a few concrete objects such as clocks and study money for the learners to work with.”

R.P 1 Spiki-Lee also said that the Department of Education graciously supplied them with a set of six brick counters during the preceding academic year. The six bricks are colourful toys, such as Lego pieces, providing learners with the opportunity to freely construct and deconstruct them (Figure 7).



Figure 6: Example of formal Manipulatives six bricks

Based on interviews and observations of the participants, the researcher determined that Spiki Primary possessed a variety of formal Manipulatives, such as:

- Unifix Cubes
- Abacus
- Clocks
- Fraction Strips
- Study Money
- Six bricks
- Counters
- Knobless Cylinders

Regrettably, Pentse Primary, situated in Bloemfontein's townships, faces the challenge of limited access to a wide variety of formal Manipulatives that are essential for educational purposes. This limitation arises from the school's classification as a quintile 1 institution, which solely relies on the basic department budget allocation as its primary source of funding, without any additional income streams such as parental school fees such as at Spiki Primary. Consequently, the main resources applied by the participants (Pentse-Reed and Pentse-Lesedi) consist mainly of natural materials or the inventive creation of their own materials.

However, R.P 5 Pentse-Lesedi utilised an abacus (Figure 7) in her lesson, although not all the students had access to one. She explained: *"The school does not have much money to buy an abacus for each child, so the parents are the ones who are supposed to buy them, but as you can see, only about 15 learners in the class have them"*.

Nonetheless, she offered some consolation by stating that despite the challenges, she makes an effort to divide the learners into smaller groups in order to facilitate the sharing of the abacus and ensure that each learner has an opportunity to use it.



Figure 7: Abacus

To summarise this theme, data revealed that teachers use a mixture of both formal and informal Manipulatives. Participants are able to creatively use the different attributes of Manipulatives to teach diverse concepts. Furthermore, teachers are encouraged not to be deterred by the lack of formal, colourful Manipulatives in the classrooms, and to be inventive by using objects from their immediate environment. As literature has demonstrated (Laski, 2015 and Maboya et al., 2020) the effectiveness of Manipulatives as instructional tools depends on the context in which they are used, a topic that will be discussed in greater detail later. Any 3D tangible object that is safe to use and topic-appropriate, passes the test as a Mathematical Manipulatives, and teachers should keep this in mind when selecting Manipulatives for their classrooms.

4.5 THEME 4: ROLE OF THE TEACHER DURING MATHEMATICS LESSON USING MANIPULATIVES

The initial three themes of this study offer a preliminary overview of the nature of Manipulatives and the various forms of Manipulatives commonly employed by teachers. The researcher now focuses on examining the extent to which teachers, particularly those in Bloemfontein, a Free State city, are knowledgeable about the proper use of Manipulatives.

The researcher was able to deconstruct the way in which teachers use Manipulatives into three subthemes:

1. Effective approaches for introducing Manipulatives in Grade 1
2. Scaffolding
3. Collaborative learning

All three subthemes are concepts derived from the works of Lev Vygotsky. Considering this, Vygotsky's Sociocultural Learning Theory serves as the framework for the analysis of the interviews and observation data.

4.5.1 Effective approaches for introducing Manipulatives in Grade 1

R.P 3 Spiki-Evelyn's classroom, designated as a quintile 5 school, has a total of 33 learners. She has accumulated four years of teaching experience at Spiki Primary. Patterns, the second content-learning area according to the CAPS document (Caps, 2012), was the lesson of the day for her learners. With much enthusiasm, she gathered the learners on the carpet in front of her, subsequently taking out a compact blackboard and a set of chalks.

The participant inscribed the term "patterns" onto the blackboard and continued telling the learners that the subject matter for the day's class would revolve on this concept. She began posing perceptive questions to them such as: *"who remembers what patterns are?" "Can you all look around the classroom and see any patterns?"* In response, one of the learners confidently pointed out, *"The curtains, teacher! They have red, pink and green flowers only."* *"Correct!"* The participant exclaimed. The participants' act of connecting the concept of patterns to the real-world experiences of learners was indeed a great one, as this plays a significant role in how young learners learn.

She then proceeded to inform learners that they would engage in the creation of diverse patterns using Lego-like cubes. The participant was talking about the six bricks recently donated by the Department of Education to the school. The learners, especially boys, were immediately intrigued, fascinated, and eager to see these six bricks. They went from being relatively calm to sitting in expectation and yelling with excitement immediately.

Upon careful observation of the Mathematics session and the conduct of the learners in the classroom of R.P 3 Spiki-Evelyn on patterns, it became evident that the learners had not been exposed to or engaged in activities involving the six bricks, despite the fact that the said materials had been sitting in her storeroom for nearly a year. This was demonstrated not only by the learners' enthusiasm and confusion on what six-bricks were, but also by one of the fellow pupils raising her hand and asking, "*Teacher, what are Lego blocks?*" The researcher instantly noted that once the learners were given the six bricks, they were very chatty, excited, and began building their own creations, completely forgetting that they were in the middle of Mathematics class.

This was because they were unfamiliar with the Manipulatives, and the participant had not provided them with any rules on how to act once they had the Manipulatives in their possession, especially since they had never used them before. When I asked the participants about some of the challenges they faced when working with Manipulatives, they all mentioned discipline issues and learners who were overly enthusiastic. This was confirmed by Uttal et al. (2009) who claims that using Manipulatives detracts from authentic learning and may not increase performance (Carbonneau, Marley, & Selig, 2013). Learners may become sidetracked if introduced to Manipulatives without first receiving proper instruction and direction from the teacher.

However, this need not be the case as an effective strategy for mitigating off-task behaviour among young learners is to establish clear and explicit classroom rules as a primary measure. Similarly, Liggett (2017) argued that the implementation of teacher-directed learning is necessary to provide a sense of control and order within the classroom. This can be achieved, for example, by providing learners with an explanation to the learners that Manipulatives should not be regarded as mere toys, but rather as tools designed to facilitate the discovery of solutions and comprehension of Mathematical techniques within the classroom.

Furthermore, It is imperative to provide appropriate disciplinary measures to learners who demonstrate a lack of respect towards Manipulatives by engaging in disruptive behaviours, such as throwing them around or disregarding directions from the teacher. Unfortunately, R.P 3 Spiki-Evelyn, did the opposite of this by immediately distributing the six bricks to the learners, without adequately articulating the learning goals and desired outcomes of the lesson. This led to the learners being extremely restless and eager to play. It does not imply that she lacked proficiency in correctly using Manipulatives; rather, it underscores the importance of teachers envisioning an optimal classroom culture when including Manipulatives in their lessons. Therefore, during the lesson planning phase, teachers must consider how Manipulatives will intersect with their own vision and where they will not. Moreover, to build a comfortable environment for everyone, they ought to consider the adjustments they may need to make. These visions will assist them in formulating the framework for their rules (Rowley, 2020).

During R.P 2 Spiki-Chimbi's class, similar disruptive, distracted conduct was observed from the learners due to lack of rules. In a classroom consisting of 34 learners, the participant distributed individual boxes of locally sourced vibrant sweets to each learner. At first glance, this appeared to be a creative approach to incorporating a type of informal Manipulatives into her lesson; however, like R.P 3 Spiki-Evelyn, the learners were fidgety, lost concentration, and exhibited sneaky behaviour when they began to hide or eat the sweets.

When she was questioned on why she had chosen sweets in particular, she said: *"They are colorful, small, easy to work with, and obviously grab the learners' attention."* The attention of the Grade 1 learners was indeed captured, albeit in a manner that did not contribute to the advancement of Mathematical learning, but rather in a light-hearted and recreational fashion. In her attempt to create an inclusive and engaging lesson, the participant failed to clarify the following rule to the learners: *"You may not eat any sweets, or you will not be able to participate in the activities. After the lesson you will also get a chance to eat them but if I see you have missing sweets, I won't give them to you to eat afterwards."* Thus, in keeping with existing research, it is recommended that teachers provide specific

explanations of the connection between Manipulatives and Mathematical concepts. The expectation of young learners to establish a connection between concrete materials and the corresponding Mathematical lesson without explicit guidance is deemed unreasonable (Rowley, 2020:6; Furner and Worrel, 2017). The behaviour of the learners quickly became overpowering for both participants (R.P 2, R.P 3), necessitating the use of a variety of discipline techniques that required considerable teaching time.

Furthermore, this indicated that teachers should ideally steer clear of Manipulatives with distracting or unnecessary features or those that mimic common things. Manipulatives that are representations of real items have been shown to be counterproductive to learning. In fact, Carbonneau et al. (2013) found that the use of Manipulatives in teaching had limited effectiveness for learners aged three to six years, resulting in minimal or even negative outcomes, which could be explained by the presence of overstimulating Manipulatives in early childhood classrooms. Ultimately, the most effective Manipulatives are those that are as simple as possible (such as unifix-cube cubes versus sweets) and lack any linkages to real-world items or other perceptual qualities.

The success of using simpler Manipulatives was recorded in the lesson observation of R.P 4 Pentse-Reed, who possessed 17 years of professional experience. She effectively facilitated a lesson on Sharing using basic uni-fix cubes. The learners demonstrated high levels of success and maintained good concentration throughout the activity. This was due to the fact that the participant initially provided a definition of the concept of sharing to the learners, followed by a demonstration on a whiteboard illustrating the method of how to share the uni-fix cubes.

Next, she handed a collection of uni-fix cubes and chalks to each learner. The participant employed phrases such as: *"Share 9 biscuits between 3 friends"*. Learners proceeded to draw out three circular shapes on their respective tables using chalk, as depicted in Figure 8. The unifix cubes were divided into the circles, and the simplicity of the unifix cubes increased the learners' concentration and

engagement in comparison to the use of highly stimulating objects. It was not necessary for her to use actual biscuits for learners to be intrigued.

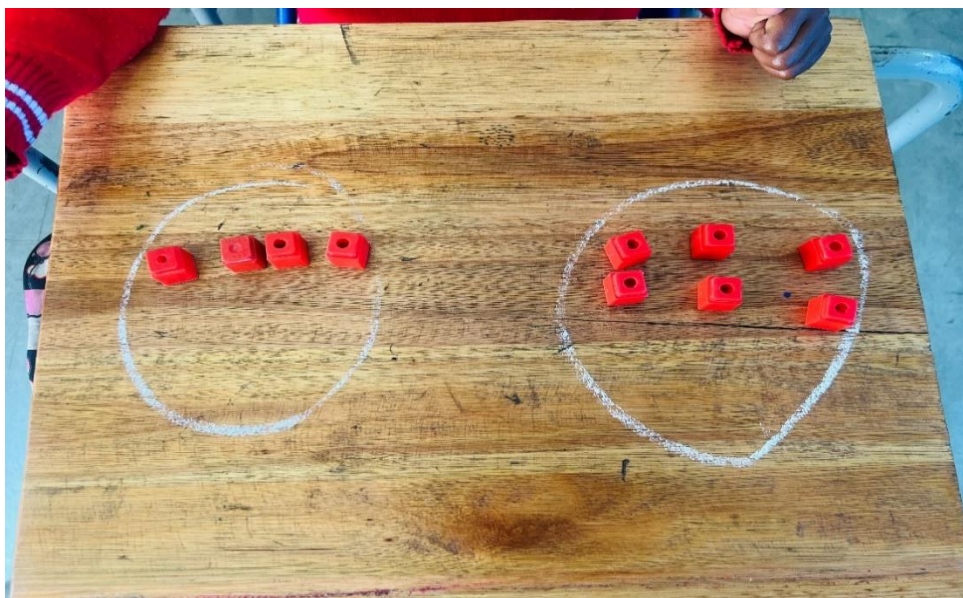


Figure 8: R.P 4 Pentse-Lesedi lesson using Unifix cubes

The above observations highlight the significance of knowing and understanding how to introduce Manipulatives into lessons. It is advisable for teachers to initially choose suitable Manipulatives for their lessons while refraining from the notion that, due to the early age of learners, they must procure objects with exceptionally distinctive attributes.

R.P 4 Pentse-Reeds' professional experience likely informed her understanding of best practices when working with Manipulatives, including the importance of establishing rules and selecting suitable yet uncomplicated materials. Regrettably, Research Participants 2 and 3 failed to adhere to these principles. For this reason, teachers should not be afraid to explain to learners the lesson's objective, the Manipulatives' function, and how to connect the Manipulatives to the Mathematical concept. Teachers should persist in facilitating an environment of free play, wherein learners are able to actively engage with the six bricks, thus fostering opportunities for self-discovery and the construction of new knowledge. This also

ensures that, as time passes, learners become accustomed to the six bricks and are eventually able to focus on their Mathematical properties rather than regarding them as toys (Cofone, 2020).

R.P 1 Spiki-Lee, who possesses a wealth of 12 years of teaching experience, affirmed this by stating that: *“I think Manipulatives open up discussions, but I do think if learners are not used to using them on a regular basis, and if they’re not appropriately modelled, they can become a distraction.”*

4.5.2 Scaffolding

By employing Vygotsky's theoretical framework, the researcher conducted a rigorous analysis to determine whether the participants exhibited facilitative behaviours or simply transmitted information to learners in a non-participatory fashion. they incorporated the interviews conducted with the participants along with the observations made to analyse and interpret the findings.

When the participants were asked to describe their role as teachers when working with Manipulatives, they walked me through various responsibilities. R.P 1 Spiki-Lee answered:

“Sometimes you can use Manipulatives and find that a child is completely lost or not following so I always walk around the classroom to check that my learners understand what we are doing. If I pick that a child is lost, I stop and ask her questions in such a way that she is able to correct herself using the Manipulatives.”

This was similar to the response of R.P 5. Pentse-Lesedi who explained as follows: *“My role is to firstly show the learners what I expect them to do. I will then slowly give them activities to do by themselves and see if they are able to find the answers by using the Manipulatives. For example, I will first show them how they are supposed to add two numbers together by using stones. From there I will give them more sums and ask them to find the answers.”*

According to Vygotsky, when a learner finds themselves within the Zone of Proximal Development (ZPD) for a particular activity, the provision of suitable guidance will facilitate the learner in achieving the task successfully. Nevertheless, if the learner possesses inadequate experience, it becomes imperative for the teacher to offer further assistance to facilitate the learner's progression towards the subsequent level of expertise (Margolis, 2020). This phenomenon was effectively demonstrated in the case of R, P 4 Pentse-Reeds observation during a lesson on one-to-one correspondence with a number board and coloured ice cream sticks (Figure 9). The participant randomly placed number boards over the classroom's floor. She then proceeded to designate the learners to get ice cream sticks and position them accordingly. For example, a learner would be instructed to place five ice cream sticks on the number board corresponding to numeral 5.

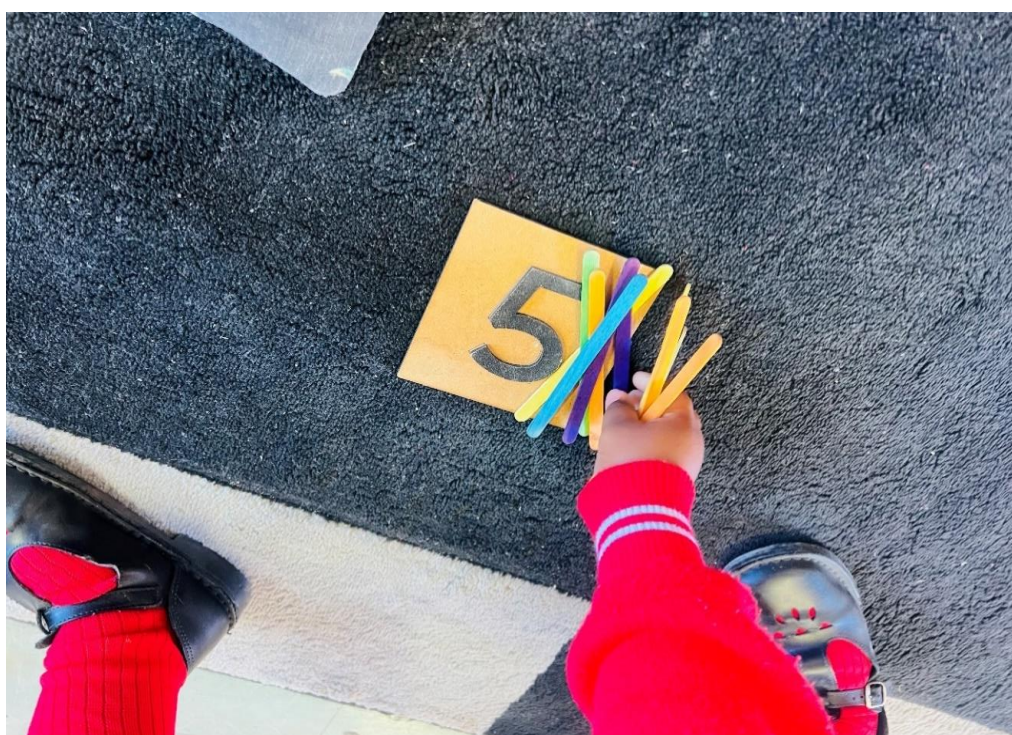


Figure 9: R.P 4 Pentse-Reed lesson using Number boards and Ice-cream sticks

In instances where a learner committed an error by incorrectly placing an excessive or insufficient number of ice cream sticks on the number board, the participant assumed the role of a guide, providing clues to the learner on how to

correct the mistake. According to Vygotsky's theory, the particular learner was in their Zone of Proximal Development and being prepared to engage in more challenging tasks by themselves.

However, not all participants efficiently scaffolded learners to understanding. A prime example of scaffolding gone wrong due to inappropriate scaffolding was experienced in R.P 2 Spiki-Chimbi (4 years teaching experience) lesson on patterns using sweets. The participant would position herself beside a learner who encountered difficulties in comprehending how to form repeating or growing patterns using the sweets. She would consistently show the learner how to continue the pattern by telling them exactly what to do step-by-step. Unfortunately, after the participant left the learners' side, the learner would still be uncertain and unable to use critical thinking abilities to solve problems. The role of the participant was not to constantly instruct the learner, but rather to assess the appropriate moments and methods for intervention.

It was evident that some of the participants with less years of teaching experience, lacked the necessary knowledge and experience to appropriately execute scaffolding, which held at risk of inadvertently providing excessive assistance to the learners. This overreliance on external support resulted in some learners adopting a passive learning stance, which impeded on their individual growth and development. According to Topciu and Myftiu (2015), when employing scaffolding tactics, it is advisable for teachers to refrain from immediate intervention and provision of advice. Rather, all learners should be allowed to complete their tasks independently. Teachers can then start by questioning the learner(s) about what they have done and what they believe should be done when they start to struggle.

R.P 5, Pentse-Lesedi demonstrated knowledge of appropriate scaffolding, as outlined in the literature, during her lesson on addition and subtraction using an abacus. She walked around the classroom asking learners open-ended questions when she noticed a learner making mistakes, such as *"Remember we need four beads on this side; does yours have four?" "What should you do to get four?"*

The learners were motivated to independently seek an answer, rather than relying on the teacher to provide instructions or dictate the next step of action. This procedure is repeated until the student attains the highest possible level of proficiency.

Another instance of scaffolding dialogue that had a beneficial impact on learners' conceptual understanding was observed in R.P 1 Spiki-Lee's Classroom. This interaction occurred between R.P 1 Spiki-Lee and a young girl referred to as Bale (pseudonym) during a lesson on Tens and Ones that included using Unifix Cubes. The discussion's first focus was on framing the idea that solo pieces are ones, and combined Unifix cubes are tens to Bale. This implies that the numerical value '23' can be decomposed into two tens and three ones. Following this, R.P 1 Spiki-Lee, delved further into Bale's zone of proximal development by presenting larger numerical values for her to decompose them into their respective tens and ones. The following conversation transpired between them:

R.P Spiki-Lee: *"So why do you have three combined pieces here?"*

Bale: *"Because they make 30'.*

Bale began to count blocks tens of times.

R.P 1 Spiki-Lee: *"And then why are these cubes not combined?"*

Bale: *"Because they are units teacher...they stand alone!"*

R.P1 Spiki-Lee: *Oh Wow, Okay! So, if I add another combined 10 pieces here, how many tens would there be?*

Bale: *4 teacher.*

R.P 1 Spiki-Lee demonstrated that engaging in scaffolding conversations with both low- and high-achieving learners led to improvements, either by enhancing comprehension or demonstrating the application of a more effective approach for the learners.

The participant was seen to have originally refrained from disclosing the answer or approaching learners. In each instance, she scaffolded learners' comprehension through careful questioning and responsiveness, highlighting conceptual connections that facilitated progress. Overall, Research participant 5 Pentse-Lesedi and Research Participant 1 Spiki-Lee, engaged in conversations with learners to facilitate in their conceptual understanding. The use of their scaffolding discussions was significant because of their strong correlation with Vygotsky's theory, which emphasises the role of language in the learning process (Bodrova and Leong, 2018). Frequently, the participants initiated these interactions by asking, "How did you arrive at that answer?" or "What are you going to do next?"

The researcher found that a significant proportion (98 %) of the participants demonstrated a comprehensive understanding of scaffolding and effectively incorporated it into their teaching methods. They conversed with struggling learners individually or in pairs while completing Mathematics tasks. At no point, during the observation of the Manipulatives lessons, did the participants sit down and ignore the needs of the learners. They promptly provided aid and intervention to ensure that their learners were not left behind.

Although Pentse Primary's substantial class sizes, accommodating up to 50 learners, presents challenges for effectively attending to each individual student; the Department of Basic Education Employment Initiatives has responded by allocating education assistants (EAs) to schools to alleviate the adverse economic consequences of the COVID-19 pandemic (DBE, 2021). EAs are not teachers, however they do possess Matric Certificates and thus are able to be of aid to Grade 1 learners. The individuals serving as assistants in the classrooms of each participant were also identified as More Knowledgeable Others who actively intervened to provide support and guidance to the learners. Despite the lack of formal training as teachers, they demonstrated the ability to effectively facilitate the development of conceptual knowledge among learners. The crucial aspect here is the role of teachers as mentors to the assistants to provide guidance to them on suitable scaffolding tactics to ensure that they avoid missteps.

4.5.3 Social interaction

“It really is tricky using Manipulatives as the learners sometimes become very excited and talking a lot to each other instead of focusing on what I’m try to teach” described R.P 3 Spiki-Evelyn.

Likewise, the researcher observed that R.P 4. Pentse-Reed exhibited signs of frustration and anger in response to learners' incessant chatting. However, interestingly, the researcher remarked that the learners were not necessarily discussing unrelated topics, but rather commenting on and demonstrating the various properties of the Manipulatives they were using and the new discoveries they were making to each other. Comparably, the learners of R.P 3 Spiki-Evelyn, R.P 2 Spiki-Chimbi and R.P 4 Pentse-Reed classrooms demonstrated a proactive attitude toward helping fellow learners who appeared to deviate from the given directions. Data thus revealed that more than 50 percent of the participants viewed social interactions during Manipulatives instruction as disruptive to their lessons. Similarly, R.P 1 Spiki-Lee and R.P 5 Pentse-Lesedi displayed a strong preference for maintaining a quiet learning environment, promptly cautioning any learners who engaged in perceived disruptive behaviour. Observation data indicates that teachers do not effectively incorporate social interactions into their teaching methods, and this fundamentally contradicts the core tenets of Vygotsky's theoretical framework, which emphasises the significance of an individual's engagement with society, the influential role of social interaction, the pivotal role of language, and the shaping influence of learning culture (Hover and Dicks, 2017).

According to Vygotsky (1978, as cited in Lantolf, 2000) the acquisition of knowledge by young learners occurs primarily through conversations and discussions. Hence, it is imperative for teachers to implement this practice in the context of classroom instructions using Manipulatives and depart from conventional memory-based instructional approaches. Discussion groups, small group learning, and collaborative activities should be implemented in educational

settings, including schools and universities, in response to theories regarding social learning (Mcleod, 2020).

It was regrettable to note that despite the learners being seated in pairs at School Spiki, all three participants failed to take advantage of the opportunity for linguistic interaction among learners. On the other hand, which was even more disappointing, at Pentse Primary, learners were seated alone at their desks, thus further reducing opportunities for social interaction to occur. Participants demonstrated a limited understanding of the idea that learners find satisfaction in helping their peers overcome their challenges. It would have been more beneficial for the participants to integrate either a specified period for unstructured play, or to cultivate collaborative activities within their Mathematics sessions such as group work, even if it was on the carpet.

Moreover, social interaction at Spiki Primary would provide significant benefits, since participants highlighted that learners receive instruction in English, which is not the primary or secondary language for the majority of their learners. Peer-discussions and group work with fellow learners would help the learners where language serves as a barrier to them.

It is imperative for teachers to provide learners with ample opportunities to actively engage in their learning processes, articulate their thoughts, tackle challenges, and partake in academic conversations with their fellow classmates (Azir, 2019). Additionally, it is crucial for learners to establish connections between Mathematical concepts and real-world experiences as outlined as one of the aims of the CAPS Mathematics Foundation Phase curriculum (CAPS, 2013). From this perspective, it is essential for the classrooms of young learners in schools to incorporate and encourage modalities and structures that facilitate social contact between the learners themselves, as well as with adults such as teachers, or with their more proficient classmates. The theory of Vygotsky and its supporters is the dominant philosophy that advocates for and emphasises the significance of the social aspect in the process of learning. Based on observations conducted at Spiki and Pentse Primary, the researcher found that the majority of teachers

demonstrated a lack of familiarity with the fundamental principles behind this pedagogical approach. Even in instances where they possess the theoretical understanding of these ideas, they encounter challenges in effectively applying collaborative learning to facilitate the enhancement of learners' psychosocial development.

To conclude Theme 4, based on the findings derived from the interviews and observation data, 33% of the participants lack the requisite theoretical knowledge and practical abilities necessary for effectively introducing Manipulatives into their lessons, as well as implementing the concepts and procedures aligned with Vygotsky's theory. This was clearly seen by the disruptive behaviour of the learners due to being highly stimulated by the Manipulatives chosen by the participants. Furthermore, participants did not display thorough classroom management skill to ensure that the lessons ran as smoothly as possible. The two participants (R.P 1 and R.P 4) who possessed a comprehensive understanding of the principles linked with Vygotsky's theory, acquired knowledge of these concepts during their formal education, as well as having more extensive professional experience and having attended many workshops and trainings.

In the context of classroom observations and scaffolding, only 2 out of 6 participants demonstrated proficient use of scaffolding techniques during teaching Mathematics with Manipulatives. Despite the verbal explanations of the other 4 participants during interviews, which they believed were indicative of the assistance they provided to learners, they did not manage to demonstrate that the assistance they provide to each child within the ZDP, through scaffolding, is individualised and specific, as opposed to generic, and the same for all learners.

An example of appropriate scaffolding was in the initial scenario of R. P. 1 Spiki-Meyer who offered personalised support based on the unique capabilities of Bale. The participant recognised that Bale required support to fully comprehend the concepts of tens and ones. This support was provided through the implementation of diverse scaffolding techniques such as posing questions, engaging in

communication and interaction through language, modelling, and building upon prior knowledge to facilitate the transition to a higher level of cognitive recognition. In accordance with the extensive observations conducted in various Grade 1 classrooms, participants had ample opportunities to effectively employ Manipulatives in conjunction with collaborative learning. However, none of the participants used this instructional technique. In essence, they deprived their learners of the opportunity to promote child-centered teaching and facilitate individualised learning.

Findings on teachers' ability to effectively use Manipulatives found that further development is required to:

- Create a learning environment for learning that allows them to complete tasks with assistance and support from teachers and other more advanced pupils.
- Teachers should engage in systematic observation and monitoring of learners' psychosocial development to discern their present level of development and potential for growth. This understanding should inform the type of Manipulatives appropriately situated within the learners' Zone of Proximal Development (ZPD).
- Teachers must exercise caution to ensure that their scaffolding is not confused with directed instruction.

4.6 THEME 5: "NAVIGATING THE HURDLES: TEACHER CHALLENGES IN IMPLEMENTING MANIPULATIVES"

The final theme of this study focused on gathering perspectives from participants and collecting observational data to identify the challenges that impede the implementation of Manipulatives teaching methods for teachers. The researcher believes that this makes room for future research on the support that teachers in schools should have to help them teach Mathematics using Manipulatives.

4.6.1 Overcrowding

R.P 5 Pentse-Lesedi firmly expressed the challenging nature of consistently employing Manipulatives in the classroom, citing the impracticality of controlling a group of 50 young learners and the inevitable occurrence of disruptive behaviour. According to R.P 4 Pentse-Reed, she asserted that the presence of a large number of learners in the class severely hampers mobility: *“I can barely move in the class due to how many learners there are. The class is overcrowded so it is not easy for me to walk around and ensure that all learners are following”*.

According to R.P 5 Pentse-Lesedi, the presence of more learners in a classroom leads to a natural increase in the noise level. Despite her strict teaching style and years of experience, young learners often become easily distracted which was seen. As was observed in the R.P 2 Spiki-Chimibi classroom, the greater the number of learners, the more difficult it is for teachers to teach and for learners to concentrate in classrooms with increased noise. While R.P. 2 Spiki-Chimbi worked tirelessly to eliminate noise in order to teach, a great deal of time was squandered.

Moreover, in the context of Pentse Primary, the participants implemented scaffolding strategies by assisting learners who they predicted to encounter difficulties. However, it proved challenging to extend this support to every individual learner as a More Knowledgeable Other. In instances where the number of learners in a classroom increases, teachers are unable to allocate an equivalent amount of time to each individual student. If a learner was struggling to comprehend a particular topic, it was almost never possible to assist him or her because there were at least 40 other students in the class.

During observations, it was evident that majority of the participants had a tendency to provide assistance to learners whom they anticipated would encounter difficulties, while inadvertently neglecting those individuals who were thought to possess a higher aptitude for acquiring knowledge. This behaviour can be attributed to the inherent challenges posed by the substantial class sizes. Unintentionally, certain participants overlooked learners who were similarly in need of guidance inside their Zone of Proximal Development (ZPD).

Regretfully, R.P. 4 noted that struggling learners fall further behind as a result of overcrowding. Learners who are of average academic ability or below average academic ability are likely to encounter significant challenges in making progress inside a classroom that is overcrowded. They need more attention, resources, intervention, and occasionally personalised support, notwithstanding the presence of Manipulatives.

Participants expressed the view that Manipulatives did not possess inherent magical properties that facilitated comprehension in the context of a crowded learning environment; rather, for some learners, they serve as a fertile foundation for playfulness.

Kosie (2022) asserts that the prescribed Learner-To-Teacher (LER) ratio in South African educational institutions stands at 30:1. However, this phenomenon does not occur at either Spiki or Pentse Primary schools. The classrooms at Pentse Primary accommodated a considerable number of learners, with up to 50 learners per class. The class size presented difficulties that were almost hard to solve or even get over, such as providing problematic students with the right scaffolding and making sure all students were using Manipulatives to complete the tasks assigned to them.

As previously demonstrated, Manipulatives must be applied in conjunction with other methods of teaching. The researcher is of the opinion that, embracing Vygotsky's ideas about social interaction and collaborative learning is one way to prevent learners from falling further behind. Rather than depending solely on teachers' individual efforts to support every learner, they could ask advanced learners to provide aid to their peers. Therefore, using the technique of peer-discussions and group work alongside Manipulatives can be advantageous and enjoyable, especially where teachers are not able to reach all the learners.

4.6.2 Lack of resources

Another challenge R.P 1 Spiki-Meyer mentioned was regarding resources. She stated that:

“You’d want them to have enough so that everyone can get a part of the experience but sometimes there aren’t enough resources to do that so whereas it’s better for them to do it in partners, you may have to do it in groups of fours because of what you have.”

Although she admits that she is from a school that is privileged in terms of financial resources from the parents and SGB, it is a reality that there are certain schools that do not have the advantage and thus, do not benefit from a variety of Manipulatives. Availability is one of the most important factors affecting the use of Manipulatives because if they are not there, teachers cannot use them. This reality was evident at Pentse Primary. As a result, the participants use informal Manipulatives, such as stones and bottle tops, as tools to support the learning process. Often, the participants also rely on creating their own resources from raw materials to mitigate the unfortunate reality of not having formal, Montessori Manipulatives.

Even though the participants identified a resource shortage as a problem, this need not always be the case. Literature (Carbonneau et al., 2013) indicates that less colourful Manipulatives are actually preferable because they allow learners to concentrate more on Mathematical processes when solving a problem. As a result, teachers should be equipped to use a variety of informal Manipulatives, such as straws and pencils, that they can find in their immediate surroundings and incorporate into their lessons. Additionally, when inquiring about the permissibility of learners taking Manipulatives home for more practice, both participants from Pentse Primary responded negatively.

According to R.P 5 Pentse Lesedi:

“I don’t mind if a parent reaches out to me to ask to borrow a Manipulatives such as the unifix cubes and abacus, but they must be brought back after a period of time.

R.P. 4 Pense-Reed, on the other hand, stated that she encourages the use of Manipulatives at home and gives parents ideas of what they can use to assist learners, such as stones. However, the Manipulatives in her class may not be allowed to go home due to a limited supply, and she fears that learners may not return them to school. However, considering that the participants themselves reaffirmed that they regularly use alternatives and that they encourage parents to do the same at home with their learners, evidence does not support the notion that a lack of resources is a sufficient justification for not using Manipulatives to teach Mathematics.

4.6.3 Time

During the interviews of the participants, all five of them expressed without hesitation that the biggest challenge in implementing Manipulatives during Mathematics teaching was time. R.P 2 Spiki-Chimbi explains:

“To use the Manipulatives then you have to factor in time. They have to have enough time to use them; they have to have enough time to play with them or to figure things out and that takes time because either they’re working as a group and they have to figure things out or they are doing it independently then they have to go through the process of figuring out what they have to do; and unfortunately, due to the ATP, as a teacher, we are pressed for time to get through the content so I do not use Manipulatives as often as I would like to.”

To compensate for this challenge, the researcher acknowledged that the participants would schedule the appropriate length of time for that specific Mathematics course, which changes from topic to topic, using their own expert judgment.

R.P 5 Pentse-Lesedi reiterated:

"I sometimes do double periods, or 120 minutes of Mathematicss, because I have the professional freedom to make the lesson longer. The next day, I might cut it shorter."

When the researcher probed the participants on how often they used Manipulatives in their lessons, none of them used them for most of their lessons in a week. In other words, out of five school days in a week, participants cited using Manipulatives for an average of 1 day in a week. For example, R.P 2 Spiki-Chimbi explained that she finds Manipulatives most useful when introducing a new topic such as subtraction. Once the learners have developed proficiency in showing the process of subtraction physically, she moves onto semi-abstract activities such as pictures and symbols.

R.P 5 Pentse-Lesedi also acknowledged that she does not use Manipulatives for any other reasons besides either introducing a difficult concept such as double and half, or as a form of aid for learners who are still at the concrete stage of understanding. She said:

"Because of curriculum coverage, there isn't enough time in a day to allow learners to have a free period where they just play with Manipulatives. there are other subjects I need to get through and not enough time."

Similarly, R.P 4 Pentse-Reed said:

"The department gives us ATPs (Annual Teaching Plans) which we need to cover with the learners until the end of each term. We are given a time framework of how much to spend on each Mathematics topic before moving on so in as much as I would prefer to use Manipulatives more often, CAPS actually does not allow me to. When the subject advisor comes, she doesn't care what your learners need, she just wants to see your file and learner books to make sure you are keeping up with the ATP."

A common recurring theme from participants was that using 3D concrete objects to teach Mathematics takes patience and time which the CAPS curriculum

unfortunately does not grant them with. R.P 1 Spiki-Meyer went as far as to exclaim:

“Remember on top of Mathematics, there is still a subject called Life Skills which has 4 Learning Topics. I can barely find time to do physical education with my learners let alone play with Manipulatives. I do my best, but the curriculum is expecting more writing work from the learners.”

The data revealed that there exists a conflict for teachers between the rapid pace demanded by curriculum trackers and the slower pace at which learners progress. The decision to accelerate the pace to cover the curriculum compromises the overall quality of the learning experience; and curriculum coverage trackers fail to consider the diverse circumstances of various educational institutions as was suggested from the interviews.

There is a prevailing argument that amongst teachers that, although CAPS has effectively offered them with explicit curriculum advice, it has failed to adequately recognise the substantial diversity in learners' proficiency levels. It also has not helped teachers get the subject-matter expertise and pedagogical understanding they need to effectively instruct students who are not all at the same Grade level.

Moreover, Goetze (2016) argued in her article that the CAPS curriculum is excessively laden with content, resulting in insufficient time for learners to establish a strong understanding of the taught topics. As a result of the content-heavy curricula, certain learners developed a shallow understanding of the course material, which hinders the development of a strong foundation.

The researcher observed this in R.P. 2 Spiki-Chimbi's class, where using the Manipulatives for the first time energised some of the learners. It became evident that there was a lack of sufficient engagement in free play or personal leisure time with Manipulatives, which can lead to significant delays in emotional and social development. Furthermore, it is worth noting that Mathematics is a discipline that necessitates ample practice. Regrettably, as reported by the participants, there

appears to be a lack of time allocated for reinforcing knowledge. Regardless of the participants' level of professional expertise, they unanimously expressed their concern that the curriculum progresses rapidly from one topic to another, without allowing sufficient time for consolidation. A limited number of learners possess the ability to effectively manage the frequent shifting of abstract ideas.

Thus, this approach of not engaging in sufficient practice fails to facilitate the development of comprehensive understanding and instead causes confusion among learners with ordinary to below average cognitive abilities. The consolidation of concepts is necessary for the majority of learners, and it should not be limited to a single occurrence. This assertion is supported by Northern Illinois University (2022) which suggests that while scaffolding with Manipulatives is essential, it also entails significant time and effort due to the following factors:

- Choosing scaffolds that are suitable for the various learning and communication styles of the students.
- Being aware of when to take down the scaffold so the pupil is not dependent on it.
- Lack of sufficient knowledge about the cognitive and emotive capacities of the pupils to offer suitable scaffolds.

Notwithstanding these concerns, it is imperative to recognise that the CAPS Curriculum has undergone many adjustments and enhancements throughout the years, and it continues to develop in accordance with feedback and research. Furthermore, several variables, such as community support, family involvement, teacher preparation, and resource allocation, determine the curriculum's implementation and efficacy. Given the points raised by the teachers, curriculum planners, policy makers, and curriculum consultants ought to reevaluate how much time is allotted to the teaching of Mathematics topic to allow for consolidation and practice for the learners.

4.7 CONCLUSION

In this chapter, the researcher outlined the five primary themes used to organise the data obtained through observations and interviews. Based on the research conducted, it was found that all five participants expressed the view that Manipulatives are a crucial element in the instruction of Grade 1 Mathematics. They acknowledged that manipulating objects as a teaching approach fosters holistic learning and that it is suitable for usage in the foundation phase. However, it was found that only two participants demonstrated a proficient understanding of how to use Manipulatives in the classroom in a manner that mitigates their potential to be a source of distraction. This can be credited to their extensive years of teaching experience. Furthermore, at the chosen schools, the use of Manipulatives as a teaching and learning approach was hampered by either a lack of resources or time. The results showed that department administrators' lack of support for teacher effectiveness hindered their ability to promote Foundation Phase Manipulatives teaching and learning, a shortcoming that appears to have gone unnoticed. The discussion of the findings also covered literature.

The study is summarised in the next chapter, which offers recommendations based on the research's conclusions.

CHAPTER 5: CONCLUSIONS AND IMPLICATIONS

5.1 INTRODUCTION

The recognition of the value of Manipulatives and their impact on the learning and development of young learners in Mathematics has garnered attention from researchers, theorists, teachers, and policy makers. Thus, this study sought to investigate the extent to which Grade 1 teachers in South Africa efficiently use Manipulatives during Mathematics instruction, as well as the challenges they encounter in the classroom.

Research on the historical and theoretical aspects of manipulatives for teaching mathematics has revealed a strong connection between teachers' attitudes toward manipulatives and their impact on learning outcomes and teaching practices in mathematics lessons. Therefore, this study sheds light on the types of Manipulatives teachers use and whether they can give an effective lesson with them in light of the challenges unique to advantaged and disadvantaged Grade 1 classrooms. In this chapter, the researcher discusses how effectively the theoretical framework met the requirements of the research problem and provides an overview of each of the other chapters. The study's general objective, the research problem, and the research questions that have emerged as a result of the research will be analysed, along with the study's primary conclusions. This chapter will review the limitations found throughout the research. It will also recommend for future research. Lastly, a full summary of the study's findings will be provided.

5.2 REFLECTIONS ON THEORETICAL FRAMEWORK

To better understand how young learners gain knowledge and the role that teachers play in classroom teaching and learning, Chapter 2 used Lev Vygotsky's Sociocultural Theory as a lens. This theoretical framework helped the researcher understand the ideal circumstances required to use Manipulatives in the classroom; allowing them to concentrate on the ways in which teachers' attitudes shape their practise in response to potential difficulties in the South African

classroom. His most well-known contribution to the field is his sociocultural theory of development, which highlights how social interactions and cultural background influence cognitive development (Cherry, 2023). By employing this theoretical framework as the foundation for the complete research investigation, it was possible for the researcher to address each of the research questions posed in this study. According to Vygotsky, a child's social and cultural environment during their upbringing has an impact on their cognitive development in addition to their inherent skills (Kimmons, 2018). Learners pick up information through their interactions with classmates, parents, and instructors, among other educated people. These interactions facilitate the essential direction and support required for youngsters to cultivate higher cognitive capabilities.

Moreover, he introduced the concept of the Zone of Proximal Development (ZPD), which posits that a person with greater expertise might facilitate a student's learning by providing guidance in a task that is beyond their current skill level (Cherry, 2020). As the student's proficiency increases, the level of support provided by the expert or instructional material diminishes progressively, enabling the student to independently execute the skill.

From a Vygotskian standpoint, Manipulatives are a type of scaffolding, which is a method in which an object aids a student within their Zone of Proximal Development (Kampen, 2020). Fortunately, the participants employed a diverse range of Manipulatives to provide learners with assistance throughout a Mathematics instructional session.

The participants, unfortunately, did not entirely buy into this viewpoint, which questions the widespread belief that a person's natural intelligence is the main determinant of how well their brain develops. Because of this, Vygotsky's claim that learners are shaped by social interactions and the use of languages was not considered, and participants instead depended on their own efforts to scaffold learners into understanding. In addition, only 33% of the participants provided helpful scaffolding, and some did not allow learners sufficient time to explore a Manipulatives to infer their own knowledge.

5.3 MAJOR FINDINGS FROM THE RESEARCH

The key findings of the study are described in Table 5.1. They correspond to the five overarching themes that emerged from the data. Teachers, parents, and other relevant stakeholders can use the provided interpretations and implications as a road map for incorporating effective Manipulatives use into their early childhood Mathematics lessons.

Themes	Key Findings	Interpretations and Implications
1. Defining Manipulatives	Regardless of the participants' school contexts and years of professional experience, they all understood what physical Manipulatives are in the Mathematics classroom.	<ul style="list-style-type: none"> Although the participants demonstrated understanding of the concept of physical Manipulatives, further instruction in the form of workshops and Professional Learning Communities (PLCs) is necessary to enhance their understanding of the various types and intricacies that define Manipulatives.
	All participants identified Manipulatives to be 3D concrete objects which learners are able to move around for the purpose of constructing deeper conceptual understanding of a Mathematical construct.	
	Majority of the participants were of the view that Manipulatives in the Foundation Phase should be colourful to be enticing to young learners.	

<p>Theme 2: Exploring Teachers’ Perspectives on Manipulatives use in the classroom.</p>	<p>Most participants acknowledged that Manipulatives are important in the Grade 1 classroom as they offer deeper conceptual knowledge for learners in various concepts such as division and fractions.</p>	<ul style="list-style-type: none"> • Grade 1 teacher possess a suitable understanding of the significance of Manipulatives as a means through which young learners enhance their Mathematical knowledge and cognitive growth. • Nonetheless, every teacher in the classroom should comprehend and apply this in a consistent manner. • In addition, it is imperative to provide learners with several opportunities to interact with Manipulatives, as a significant portion of the participants reported infrequent use of these materials. • All parties involved in putting the Grade 1 curriculum into practice should come to an agreement on the need for Manipulatives in the classroom. • It is recommended to arrange suitable training sessions and seminars in order to enhance teachers' understanding of the significance of Manipulatives in Mathematics for young learners, hence facilitating their readiness for future
	<p>Participants viewed Manipulatives as tools that allow for them to teach multiple concepts such as shapes and colours all in one lesson which aids in using their limited time wisely.</p>	
	<p>Minority of the participants agreed that Manipulatives reach learners who are facing an English learning barrier due to it not being their mother tongue.</p>	
	<p>All participants argued that Manipulatives are useful tools for learners who are still at a concrete stage of comprehension although some felt that learners can become dependent on them.</p>	

		educational advancement and personal growth.
Theme 3: Types of Manipulatives	All participants have informal Manipulatives at their disposal.	<ul style="list-style-type: none"> • All stakeholders of schools should make provision for Grade 1 teachers to have sufficient Manipulatives in the classroom- especially those who sit in overcrowded classrooms. This can either be in the form of fundraisings or donations for private entities. • Grade 1 teachers and management ought to talk about the nature of Manipulatives and reach a consensus on a suitable criterion for the methods they choose to adopt.
	Although all participants had a form of formal Manipulatives, some had a significant shortage which obviously impacted on an effective lesson taking place.	
Theme 4: Role of teacher during Manipulatives Teaching	Only 33% of the participants used appropriate strategies to introduce Manipulatives into their lessons. Other participants had inadequate knowledge on how to ensure that they introduce Manipulatives into their lessons in such a way where learners are well behaved and learning. Instead, the Manipulatives became a distraction.	<ul style="list-style-type: none"> • The design and organisation of instruction and curriculum should be developed to surpass the child's existing level. • The learning environments that teachers create for their students must allow them to complete tasks with assistance and support from teachers and other, more advanced learners. • Teachers ought to monitor and track the psychosocial growth of their learners in
	Majority of the participants acted according to	

	<p>Vygotsky's theory of using scaffolding to support learners in the classroom. The participants with less teaching experience scaffolded to a point where they were telling learners exactly what to do and not allowing them with space to figure out knowledge for themselves.</p>	<p>order to assess both their present state and future potential. After that, they should design lessons that fall within the learners' zone of development.</p>
	<p>None of the participants showed understanding in using Manipulatives together with collaborative learning as per the sociocultural theory. Participants did not maximise peer learning, group work and collaboration which does not enhance knowledge for many learners and goes against Vygotsky who notes that learning is a social process. They were more concerned with learners being quiet and solving problems the traditional way- by themselves. They believed Manipulatives alone were sufficient to assist learners.</p>	<ul style="list-style-type: none"> • Instructors need to exercise caution so that learning with assistance is not confused with being given instructions. • The implementation of workshops and departmental interventions, complemented by class visits, is vital for the purpose of providing teachers with the necessary training to successfully employ Manipulatives in their teaching methods. • It is recommended that Grade 1 teachers implement a systematic approach to documenting Manipulatives-based practices in order to enhance the visibility of learning outcomes for all stakeholders.

	This has thus led to a disconnect between teachers' beliefs and their practices.	
Theme 5: Navigating the Hurdles: Teacher challenges in implementing Manipulatives	Participants teaching at quintile 1 schools do not face an overcrowding challenge however, through interviews and observations it was noted that quintile 1 schools are overcrowded which limits the teachers' ability to effectively apply Vygotsky's strategies to teaching and learning. Secondly, behavioural challenges due to class sizes was obvious.	<ul style="list-style-type: none"> • Weekly and monthly meetings are useful for informing stakeholders about the learning process and obstacles they encounter, but often fall short because of the lack of support from stakeholders. • All Grade 1 teachers should have access to high-quality seminars and teacher training, regardless of where their schools are located. • Additionally, foundation phase centers must schedule frequent community meetings in order to determine the best way to address structural obstacles given the resources at their disposal. • It is imperative for parents to receive training on the benefits of Manipulatives in order to enhance their support for teachers.
	Although participants made use of informal Manipulatives to the best of their abilities, not all South African schools are in possession of formal Manipulatives. In some instances, there was a shortage of Manipulatives in the classroom. This led to teachers' negative attitude towards regularly using Manipulatives.	
	A consistent challenge by all the participants was lack of time to maximise	

	<p>the use of Manipulatives in their instruction. The curriculum is replete with content and very little time to allow for free play or to use Manipulatives as regularly as possible as they require time.</p>	
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Table 7: Summary of findings and implications

5.4 LIMITATIONS

The main limitation of this study resides in the sample size. It was possible to interview only five individuals due to the Master of Teaching programmes time constraints. To obtain an accurate understanding of teachers' opinions regarding Manipulatives and their impact on classroom usage, a larger sample size is necessary to ensure a representative portrayal of the whole population. Furthermore, a larger sample size would likely better reflect the opinions and practices of Motheo District Teachers. Moreover, generalisability may be indicated by the study's use of five sample sizes from just two Grade 1 schools in a specific area of Bloemfontein. The limited amount of time available for this study is another drawback.

5.5 CONTRIBUTION TO RESEARCH

Although this research has certain limitations, it will stimulate more research on teachers' use of Manipulatives. With a thorough understanding of how Manipulatives are used in the classroom, policy makers and administrators will be able to decide what kind of professional development courses or training for Foundation Phase teachers would be most beneficial. For individuals who are curious about the use of Manipulatives in Mathematics, the study will also offer more information. Furthermore, study participants' backgrounds and social settings will shed light on the types of learning opportunities that lead to improved

behaviour. More significantly, the research project provided participants with a platform to express their opinions and views.

5.6 RECOMMENDATIONS FOR FUTURE RESEARCH

This section contains the following suggestions for additional research:

- The subject of virtual Manipulatives came up multiple times during the literature review stage. The decision to exclude virtual Manipulatives from the scope of this research study was motivated by the recognition that their inclusion would introduce numerous additional variables, such as the accessibility and use of technology within the classroom environment, as well as the potential influence of technology on learning outcomes. Although the researcher did not set out to explore this, they suggest that, given the rise of technology in South African classrooms due to the recent COVID19 pandemic, the use of virtual Manipulatives merits additional research.
- The way that South African teachers incorporate Manipulatives into their courses may be improved with further research on how Foundation Phase (grade R-3) learners view the role that these tools play in education.
- Investigating how parents' opinions of Manipulatives may affect learners' views and use of them could also be helpful, particularly in Township, quintile 1 schools.

5.7 SUMMARY

Learners' learning and growth of Mathematics depends greatly on the use of Manipulatives. According to the Grade 1 participants' experiences in this study, teachers use Manipulatives to organise lessons and support learning, but they lack precise instructions on how to carry out their plans in a way that will truly benefit learners' learning rather than hinder it. Additionally, several challenges have surfaced that consistently affect teachers' capacity to employ Manipulatives as a teaching approach. Among these difficulties are the Department of Education's lack of support for offering workshops and resources that improve teachers' comprehension of how to effectively integrate Manipulatives, as well as the

ongoing problem of overcrowding and time constraints brought on by the CAPS curriculum.

In some classrooms, learners and teachers were negatively impacted by a lack of teaching and learning resources, and while there was evidence of the use of Manipulatives to support learning, there were obvious shortcomings in the teachers' understanding of how to use these tools inclusively to support the learning of all students. Given that Grade 1 is a part of the Foundation Phase, which lays the foundation for later learning, these issues require prompt treatment. Without a solid grounding in the basics, learners are unlikely to be able to make up for lost time in the classroom, especially in the area of Mathematics, and we will be left wondering why our educational system is failing to produce the desired results.

These recommendations are not idealistic plans; rather, they are a series of doable, everyday actions that will eventually benefit not only learners but also South Africa's future.

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APPENDICES

APPENDIX A: ETHICAL CLEARANCE



GENERAL/HUMAN RESEARCH ETHICS COMMITTEE (GHREC)

28-Mar-2023

Dear Ms Mmaphadi Motholo

Application Approved

Research Project Title:

**EXPLORING THE USE OF MANIPULATIVES IN GRADE 1 MATHEMATICS CLASSES
LOCATED IN THE MOTHEO DISTRICT**

Ethical Clearance number:

UFS-HSD2023/0104/23

We are pleased to inform you that your application for ethical clearance has been approved. Your ethical clearance is valid for twelve (12) months from the date of issue. We request that any changes that may take place during the course of your study/research project be submitted to the ethics office to ensure ethical transparency. Furthermore, you are requested to submit the final report of your study/research project to the ethics office. Should you require more time to complete this research, please apply for an extension. Thank you for submitting your proposal for ethical clearance; we wish you the best of luck and success with your research.

Please note that you should pay particular attention to mitigate a possible risk of loss of work time for participants.

Yours sincerely

Dr Adri Du Plessis

Chairperson: General/Human Research Ethics Committee

Adri
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Plessis
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Du Plessis
Date:
2023.03.29
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205 Nelson Mandela Drive P.O. Box 339
Park West Bloemfontein 9300
Bloemfontein 9301 Tel: +27 (0)51 401 9337
South Africa duplessisA@ufs.ac.za
www.ufs.ac.za



APPENDIX B: GATEKEEPER'S LETTER

Enquiries: M.Z. Thango
Ref: Research Permission: M. Motholo
Tel. 051 404 8808
Email: MZ.Thango@fseducation.gov.za



education
Department of
Education
FREE STATE PROVINCE

15555 Andrew Nche Street
Bloemanda
Bloemfontein
9323

Dear Ms. M. Motholo

PERMISSION TO CONDUCT RESEARCH IN THE FREE STATE DEPARTMENT OF EDUCATION: MOTHEO DISTRICT

This letter serves to inform you that you have been granted permission to conduct research in the Free State Department of Education within the Motheo Education District. The details in relation to your research project with the University of the Free State are as follows:

Topic: Exploring the use of manipulatives in grade 1 Mathematics classes located in the Motheo District.

1. **List of schools involved:** [REDACTED] Primary School and [REDACTED] Primary School.
2. **Target Population:** Four educators teaching Mathematics in grade 1 at the selected schools.
3. **Period of research:** From the second week of February 2023 until 30 September 2023. Please note that the department does not allow any research to be conducted during the fourth term (quarter) of the academic year. Should you fall behind your schedule by three months to complete your research project in the approved period, you will need to apply for an extension. The researcher is expected to request permission from the school principals to conduct research at schools.
4. The approval is subject to the following conditions:
 - 4.1 The collection of data should not interfere with the normal tuition time or teaching process.
 - 4.2 A bound copy of the research document should be submitted to the Free State Department of Education, Room 101, 1st Floor, Thuto House, St. Andrew Street, Bloemfontein or can be emailed to the above-mentioned email address.
 - 4.3 You will be expected, on completion of your research study to make a presentation to the relevant stakeholders in the Department.
 - 4.4 The ethics documents must be adhered to in the discourse of your study in our department.
5. Please note that costs relating to all the conditions mentioned above are your own responsibility.

Yours Sincerely,

Mr. MZAMO W. JACOBS
DIRECTOR: QUALITY ASSURANCE, M&E AND STRATEGIC PLANNING

DATE: 14/12/2022

APPENDIX C: PRINCIPAL'S LETTER



A REQUEST TO CONDUCT THE RESEARCH IN THE SCHOOL



Bloemfontein
9301

Dear Sir

My name is Mmaphadi Motholo and I am a final year MEd student specialising in Early Childhood Care and Education at the University of the Free State. I hereby request permission to conduct research in two grade 1 class at your school.

DATE: 08-10 May 2023

TITLE OF THE RESEARCH PROJECT:

Exploring the Use of Manipulatives in Grade 1 Mathematics classes located in the Motheo District.

STUDYLEADER(S) NAME AND CONTACT NUMBER:

Dr. Blanche Ndlovu

Email: NdlovuBN@ufs.ac.za

Contact nr: 051 401 2639

My research will include teacher interviews and observations which involve the examination of learners' work, teachers' documents that are used for planning, preparation and delivery of lessons as well as taking photos of both indoor and outdoor play involving manipulatives. No facial photos of learners will be taken.

Results of the research will be useful to teachers who want to understand their practices in their current context. You are assured that all information gathered will be treated in the strictest of confidence. Throughout the study, and in the report that will follow, the principles of anonymity and confidentiality will be strictly observed.

Your participation in the study would be purely voluntary and you will be free to withdraw participation at any time without any negative or undesirable consequences to yourself or the school.

Should you have any concerns about the study, you may contact me or my supervisor at the contact details listed above.

Your permission in allowing me to conduct research in your school will be highly appreciated.

CONSET LETTER SIGNED BY PRINCIPAL

I _____ hereby grant you permission to use our school for your research. I am aware that the participation of teachers in your research is voluntary and if they may feel uncomfortable, they may withdraw. In addition, I understand that confidentiality such as privacy will be always observed. I will ensure that the school functionality will not be compromised in any way. Permission has been granted.

Principal (print name) _____ Date: _____

Signature: _____

APPENDIX D: PARTICIPANTS CONSENT LETTER



Dear Participant/s

I, M. Motholo, am a Final year Masters student at the University of the Free State. My research is about Exploring the use of Manipulatives in Grade 1 Mathematics classes located in the Motheo District. I believe that this study will serve to be purposeful and meaningful to the entire school environment hence I approached you and requested for your participation.

Your participation in this study will provide suggestions and solutions on how to implement the use of manipulatives successfully and meaningfully during mathematics instruction. Furthermore, it will benefit the entire school community as effective collaboration strategies will improve the teaching and learning of the school, improve learner performance as well as creating an effective inclusion of all culturally different learners.

It is of vital importance for you to know and understand that I will be observing the classroom setting as well as the children's interaction during instruction and taking photos (no facial photos). Their anonymity is fully guaranteed such that you do not have anything to worry about as their names will not be mentioned in any of the study documents. I will ensure that the observations will not intrude with your official time at work and will take 3 school days maximum. I will also request you to tell me what time you would prefer for this interview to take place. I will be of the view that you are aware that by accepting and participating in this interview, you are granting me the freedom to use the data obtained thereof for further research, publications and policy issues and will also obtain it on request.

It is important for you as a participant to understand that:

a) Your identity and your school will never be exposed. Pseudonyms will be used when

writing this report.

b) If during the research study you feel like withdrawing due to certain circumstances, you are allowed to do so.

c) In cases where you don't want to answer questions posed, you are free to remain silent.

The information that will be collected will be used for research purposes only.

Kindly receive my contact details as well as my Supervisor's:

Supervisor: Dr. Blanche Ndlovu (051 501 2639)

Researcher: Ms. Mmaphadi Motholo (073 445 5461)

Thank you for taking time to read this information sheet and for participating in this study. If you agree to participate in this study as this is a voluntary process, below is the consent form, you are requested and ask questions of clarity if any, before you sign and return it to me

CONSENT TO PARTICIPATE IN THIS STUDY

I, _____ (participant name), confirm that the person asking my consent to take part in this research has told me about the nature, procedure, potential benefits and anticipated inconvenience of participation.

I have read (or had explained to me) and understood the study as explained in the information sheet. I have had sufficient opportunity to ask questions and am prepared to accommodate the researcher in my class. I understand that my participation is voluntary and that I am free to withdraw at any time without penalty (if applicable). I am aware that the findings of this study will be anonymously processed into a research report, journal publications and/or conference proceedings.

I have received a signed copy of the informed consent agreement.

Full Name of Class Teacher: _____

Signature of Participant: _____ Date: _____

APPENDIX E: SEMI-STRUCTURED INTERVIEW

UNIVERSITY OF THE
FREE STATE
UNIVERSITEIT VAN DIE
VRYSTAAT
YUNIVESITHI YA
FREISTATA



UFS·UVV
EDUCATION
OPVOEDKUNDE



INTERVIEW

SECTION 1: DEMOGRAPHIC INFORMATION

Aim: To explore the use of Manipulatives in grade 1 Mathematics classes located in the Motheo District.

To begin with the interview, I would appreciate if you could tell me a little about yourself and your role, duties, and responsibilities around the school. Probes here may include but not limited to participant's gender, number of years teaching, level of education etc. A checklist such as the one below will be used to capture the necessary information in this regard.

Demographic checklist

Date of interview	
Initials of Interviewer	
Years as educator	
Qualification	
Gender	
Work type	
Name of the School	
Location of the School	

INTERVIEW QUESTIONS

1. Do you know what are manipulatives? If yes, please elaborate?
2. How are manipulatives significant in young Learners' learning and development?
3. How do you prepare your maths lessons?
4. What kind of manipulatives do you often use? Why?
5. Where do you get your manipulatives from?
6. How do you show the children how to use a manipulative?
7. What strategies do you use in facilitating learning when using manipulatives?
8. Where do your learners often manipulate? Indoor or Outdoor?
9. Do you have any challenges in teaching using manipulatives, please detail what some of those challenges are?
10. If yes, please elaborate on how you deal with those challenges?

We have come to the end of our interview session; do you have any question regarding this interview?

Thank your time and your cooperation

APPENDIX F: OBSERVATION TOOL

SECTION 1: OBSERVATION TOOL

Name of teacher: Teacher A School A

Grade 1

Date:

Setting: _____

	Topic	Comment
1.1		
1.2	Does the teacher seek the learners' prior knowledge as well as offer guidance on how to use the manipulative?	
1.3	To which extent does collaborative work (social interaction) occur? Eg. group work, peer discussion	

1.4	Are there any noticeable contextual challenges that the teacher is facing?	
-----	--	--

1.5	Are prompts and cues used to help struggling learners?	
1.6	At the end, can most of the learners master the skill that has been taught without professional assistance?	
1.5	Are prompts and cues used to help struggling learners?	
1.6	At the end, can most of the learners master the skill that has been taught without professional assistance?	
1.7	Other important matters	

APPENDIX G: EDITING CERTIFICATE

NERESHNEE GOVENDER COMMUNICATIONS (PTY) LTD

REGISTRATION NUMBER: 2016/369223/07

DR NERESHNEE GOVENDER (PhD)

neresh@ngcommunications.co.za

0847022553

WRITING PRACTITIONER • EDITOR • COPYWRITER • TRAINER

PhD-Management Sciences: Marketing (gender and media); PG DIP - Higher Education - Academic Developers (Cum laude); M-Tech Public Relations; B-Tech Public Relations (Cum laude); B-Tech Journalism (Cum laude); N-Dip Journalism

15/10/2023

Mmaphadi Motholo

University of the Free State

2014074658

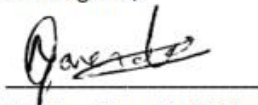
RE: EDITING CERTIFICATE

FOCUS AREA: EXPLORING THE USE OF MANIPULATIVES IN GRADE 1 MATHEMATICS CLASSROOMS LOCATED IN THE MOTHEO DISTRICT

A Dissertation submitted in fulfilment of the requirements for the Degree of Master of Education in EARLY CHILDHOOD CARE AND EDUCATION of the University of the Free State Bloemfontein, South Africa.

This serves to confirm that this research has been edited for clarity, language and layout.

Kind regards,



Nereshnee Govender (PhD)

APPENDIX H: TURNITIN REPORT

dissertation

ORIGINALITY REPORT

6%

SIMILARITY INDEX

5%

INTERNET SOURCES

1%

PUBLICATIONS

2%

STUDENT PAPERS

PRIMARY SOURCES

1

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