An exploration into how Grade 3 Foundation Phase teachersimplement differentiated instructional practices in their mathematics classrooms

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By

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Declaration of Originality

I, Nomzamo Jack (18J0001), declare that this thesis is my original work. It was not presented as part of any assessment form or a degree in any other higher education institution. Where I have used work from other scholars, such ideas have been acknowledged through quotations and references according to Rhodes University Education Department Guidelines.

15 June 2022

Signature Date

Dedication

This thesis is dedicated to my late parents. My father, Joshua Sempe and my mother, Monica Thobeka Malepato Mofoka (Poto). Ho oena ntate oaka ke ea lebuha Mokoena oa ma-Ntsane'a Monaheng! Mokoena oa Mosito! Motho oa Kali, Koena e sajeng sengwathana sa maobane, ea jang polokoe efeletse. Kuwe Dlangamandla mamam, Tolo, vumba le mpongo mlambo awuwelwa uwelwa ziinkonjane zona zinamaphiko. Intombi ezalwa nguMamQocwa, uMbizana ubutsolo bentonga. Your encouragement and push for persistence have constantly been ringing in my ears. I also dedicate this thesis to my husband, Sithembele Jack. uGqugquqgu, uZithonga, uDuka for his sacrifice. Enkosi Love. To my children. Amantshontsho am, Limpho Keorapetse and Reabetsoe Somila Jack. You have made me stronger, better and more fulfilledthan I could have ever imagined. I love you to the moon and back my babies.

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Abstract

Today's teaching space is more diverse than before. As a result, differentiated instruction is considered helpful in supporting learner diversity. This teaching approach considers socio-cultural, multiple intelligences, and learning styles also termed learning preferences of learners. It is against this view that I wanted to investigate the implementation of differentiated instruction teaching practices in the Foundation Phase. This study explored differentiated teaching strategies and procedures in mathematics teaching, and I observed four Grade 3 teachers. The theoretical framework underlying this study was the theory of practice architectures.

This study is located within an interpretivist paradigm within which I employed a case study research design. The collection of the data sets was through observations and semi-structured interviews. For an analysis of observations, I used a deductive approach. On the other hand, for the semi-structured interviews, I use an inductive approach to discover patterns and themes that I applied during the data analysis process. The validation process was done by giving interview transcripts and a summary of discussions to respondents to verify their responses and check for any misinterpretations. Rich data sets were analysed concerning the research questions, which were as follows: What are the current differentiated instruction teaching practices used by Grade 3 Mathematics teachers? How can the teachers' differentiated instruction teaching practices be understood in terms of *doings*, *sayings* and *relatings*? How are differentiated instruction teaching practices made visible through the lens of the Theory of Practice Architecture?

The findings from the study revealed that the use of learners' everyday language influences their understanding of mathematics terminology. The study discovered that learners were more comfortable using English to make sense of mathematics terms instead of using isiXhosa, the Language of Learning and Teaching in the Foundation Phase. Additionally, linking learning to learners' everyday English language enabled them to learn mathematics terms in a relaxed and non-threatening situation, while isiXhosa seemed to constrain learning. Further, the findings revealed that teachers were unclear about differentiated instruction. That was evident when they did not know the elements of differentiated instruction. Thus, the study recommends that teachers need to be supported through workshops to enable them to enact differentiated instruction in their teaching.

Keywords: Foundation Phase; mathematics; differentiated instruction; inclusive education; practices; socio-cultural; theory of practice architectures

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List of Abbreviations and/or Acronyms

ABET:	Adult Basic Education and Training
BEd:	Bachelor of Education
CAPS:	Curriculum and Assessment Policy Statement
DBE:	Department of Basic Education
DBE:	Department of Basic Education
DI:	Differentiated Instruction
DoE:	Department of Education
DoE:	Department of Education
ELSEN:	Education for Learners with Special Education Needs
EWP6:	Education White Paper 6
FP:	Foundation Phase
HL:	Home Language
HOD:	Head of Department
LoLT:	Language of Learning and Teaching
LTSM:	Learning and teaching materials
NECT:	National Education Collaboration Trust
RUMEP:	Rhodes University Mathematics Education Project
ToPA:	Theory of Practice Architecture

CHAPTER ONE: SITUATING THE STUDY

1.1 Introduction

In South Africa and in other parts of the world, mathematics teaching seems to be presenting teaching with serious problems. In the Foundation Phase, for instance, in the South African Schools' Act (SASA) of 1996, it is stated that mathematics should be taught in Home Languages (HL) (Republic of South Africa [RSA], 1996). South Africa has 11 official languages which are as follows: Afrikaans, English, Ndebele, Northern Sotho, Sotho, SiSwati, Tsonga, Tswana, Venda, Xhosa and Zulu. These languages form HLs and this varies from province to province; for example, in the Eastern Cape Province where this study was conducted the HL for the majority of learners is isiXhosa.

In an attempt to deal with the learning challenges mentioned above, the Department of Basic Education (DBE) developed the Revised Five-year Strategic Plan for the realisation of learners' performance (DBE, 2015). This plan is called Towards the Realisation of Schooling (TRS) 2030, which emphasises that challenges associated with mathematics teaching necessitate thatteachers should explore different ways of teaching the subject.

In today's classrooms, for instance, learner diversity has increased which calls for flexible instructional strategies (Suprayogi et al., 2017). Such an increase in diversity highlights that notwo learners learn simultaneously or at the same rate. Hence, differentiated instruction (DI) advocates supporting diversity in the classroom (Melese, 2019).

Differentiated instruction (DI) is a teaching philosophy based on the premise that instructional approaches should differ and be adjusted to individual and diverse learners in classrooms (Tomlinson, 2001). The key idea of DI is offering learners many opportunities to reach masteryof what they learn. Thus, DI requires a teacher to plan instruction strategically to meet the learners' learning needs and to offer numerous paths through which they can access, understandand apply what they have learnt. It takes commitment from teachers to make DI a reality. According to

Keiler (2018), the challenge for teachers seems to be the inability to move comfortably from traditional teaching methods to new and innovative instructional strategies.

In this study, I explored how teachers used DI teaching strategies in a Grade 3 Mathematics classroom. I started by observing these teachers, then interviewed them and conducted data analysis. Thereafter, I wrote up the findings and recommendations.

1.2 Background of the Study

Prior to 1994, apartheid in South Africa was an ideology that endorsed the government's interests of the time and access to schools was based on race. For many years, the education system in South Africa was divided into two streams, namely mainstream schooling[1] and special schools. The significance of the dual and segregated system resulted in large numbers of learners being excluded from mainstream education. Regular schools were called the "normal mainstream", and special schools accommodated those learners with specific learningchallenges (Wium & Louw, 2015, p. 33). In such a system, some of the learners experienced exclusion. For instance, learners seen as "slow learners" were placed in the special schools without looking at how best they could learn (Naicker, 2000). For instance, in formerly Blackschools, learners with different needs were enrolled in mainstream schools, thus depriving themof opportunities to receive additional support.

For instance, Efata School for the Deaf and Blind in Umtata, St Thomas for the deaf near King Williams Town and Luthando Luvuyo and Lonwabo in Port Elizabeth were meant for Black children who experienced profound barriers to learning. Pioneer School in Worcester was for White children who experienced visual barriers. These schools were for learners requiring specialised support; however, they were segregated based on race. In 1994, South Africa attained democracy and it transformed education for many learners with different needs who were enrolled in mainstream schools.

With the onset of democracy in South Africa, post-apartheid changes demanded that teachers be well prepared for diversity. Against this background, I became interested in understanding how teachers in diverse classrooms assisted their learners in learning mathematics. I wanted toobserve

[1] Prior to 1994, there were different types of schools. The type of schools relevant to this study is mainstream. In formerly White schools, there were also special classes in the mainstream schools. In schools for Black children, such learners were all in the mainstream classes.

how teachers implemented DI in their Grade 3 Mathematics classes. I chose the Grade3 class because it is an exit class from the foundation to the intermediate phase. I also wanted to observe how teachers used DI when assisting learners according to their different levels of understanding.

To accommodate diversity in classrooms, the DBE introduced the policy Education White Paper 6 (EWP6) in 2001. The Education White Paper 6 on Education and Training and the South African Schools Act, published in 1996, enabled the paradigm shift to inclusiveeducation (IE). The EWP6 emphasises that the education and training system should adjust toaccommodate the full range of learning needs within a mainstream classroom, except for profound barriers[2] to learning. Thus, in the South African setting, DI is a means to address learner diversity in the classroom in more meaningful ways (Walton, 2012). Thus, DI requires teachers to easily adapt their teaching strategies and demonstrate good instruction so that significant learning can occur.

In the context of this study, it was understandable that learners were likely to differ in their understanding of mathematical concepts and application of the mathematical processes. These included solving problems, reasoning skills, connecting mathematics to real life, representing mathematical ideas, creating mathematical relationships and developing mathematical thinking.

1.3 My Personal Experience: Situating Myself in this Study

I am my mother's only child, but there are nine of us from my dad's side. My mom never allowed me to grow up alone and she always had one or two siblings from my father's side. She would always say to me, "*Andifuni ukhule wedwa kuba loo nto ayilunganga. Soze ukwaziukuzimela ebomini*" [I do not want you to be raised independently. You will never be able to stand on your own in life]. Such words of wisdom enabled me to quickly get along with otherpeople.

At home, we were asked to clean the house, cook and ensure that a cup of hot tea with hot milkwas ready for them every time our parents came back from work. When we had to do these chores, we would be allocated the duties for the day. They would alternate so that everyone would have done one or two by the end of the month. As much as our parents were strict, theyallowed us to be actively involved in sports or other games. I was a dancer. I did ballroom dance, the cha-cha and

[2] Severe or profound learning disabilities may have additional difficulties such as physical or sensory impairments. Learning disabilities may be part of other conditions such as autistic spectrum disorder or Down's Syndrome among many others. These learners are not supported in the mainstream schools and instead they are in the special schools.

rumba and entered several competitions. Once more, that helped me tobe able to deal with people and understand the other person. Dancing is when couples move insteps rhythmically together, creating patterns and expressing the characteristics of the music. It could be surmised that this is an example of application of mathematics in everyday life. Thecouple also focuses on the elegance, grace and fluidity of the movements (Moore & Nichols, 2002).

My pre-school was at KwaMaMbhele where an older lady who was a former teacher opened apre-school in the neighborhood. I attended Kwa-Ford Primary school in Port Elizabeth from Sub A[3] to Standard 2. My Sub A teacher Ms Salavu who is still alive, was the best. She knew how to bring the best out of the children. I remember that at the time we were using slates to write on. There was no reference for tests because one wrote and deleted on the slate. My SubA teacher would always praise us for doing well. However, the system concentrated on the children labelled as clever. Every term, learners with positions one to 10 would be called to line up along the wall. I would always be in the first five. This went on up to Standard 2. For standards 3–5, I went to Masangwana Primary School. Here the same system applied. When Iwas in Standard 5, we were grouped according to three categories. Every Wednesday, the boyswould go to the industrial school; those who did not like or were not good at practical work would go to an Agricultural Science class. On the other side, the girls would go for sewing, and those who could not sew were taken to the Agricultural Science class. I went to an Agricultural Science class as I was not good at sewing.

I completed my high school at Cowan High school in Port Elizabeth. The school also continuedwith the system of clever learners. Here, it was based on subjects and teachers would give moreattention to intelligent learners. That meant many learners dropped out because they did not get much support. The school was partially equipped and had a library, computer lab and a science laboratory. The library and the science laboratory did not have enough books and apparatus. For instance, there were times when we could not do hands-on practical activities inthe science laboratory because of the lack of resources such as chemicals and equipment for science teaching (Asheela et al., 2021). In addition, the library was only meant to be a place tostore books. The bookshelves were not labelled and books were all over the place, which prevented us from using the library.

[3] From 1998, Curriculum 2005 (C2005) was gradually phased into primary schools. It was introduced in grades 1, 2, 3 and 7 (previously called Sub A, Sub B, Standard 1 and Standard 5). The original plan was to complete the phasing in of the new curriculum by the year 2005 – hence the name C2005.

I enjoyed working with children. As a Christian, I was also a Sunday school teacher. This wasthe space where the love of working with children began. Such love also enhanced my experience with learners when I was a student-teacher.

After obtaining my Standard 10 certificate in 1988, I completed a teaching diploma in 1989. I chose to do the Junior Primary Diploma which was done over three years. I started to teach ata primary school, where I taught English and Hygiene in Standards 3 and 4 (Grades 5 and 6). Then later, when the number of learners increased, I was asked to teach Grade 1. In the Foundation Phase (FP), I have thus taught Grades 1 to 3. At that point, I did not know about DI. That was exacerbated in part by the fact that the training at the college for teachers was based solely on didactics. According to Ducharme et al. (2012), didactic teaching denotes passing on traditional knowledge or teaching how to do something. Teachers were trained to use the lecturing style to teach knowledge or demonstrate model actions, after which learners would demonstrate what they had learnt. Reciting and repeating was a significant thing to do. However, we were also given an opportunity to do group work. Nonetheless, that kind of planning was not based on the learners' different levels of understanding; instead, the grouping was based on the various activities that the learners had to do. That was about the quantity of work not the quality of work.

As I was teaching, I was motivated to study further. At that point, I wanted to improve my qualifications. I did a Bachelor of Arts majoring in isiXhosa and Psychology. Later, I did a BEd Senior Phase in science and mathematics and later, the BEd Honours in science and mathematics. As an FP teacher, I ended up being placed in Grade 3.

During my teaching time, I would allow learners to explore. For instance, I would let my learners tell stories or create their own stories in isiXhosa. That allowed them to be creative when telling their own stories. As a result, I was able to identify learners who experienced challenges and needed extra assistance, especially in reading. Fortunately, in our school, we had a teacher explicitly dealing with that in the FP. Such learners would be taken to her classroom according to her timetable.

In mathematics, I would allow them to explore, mainly when working with capacity in measurement. All my learners would be excited every time we got to this part of learning because they would be busy measuring the amount of water in different containers, and then later they would compare the amounts of water. Indeed, the use of readily accessible resourcesto perform hands-on practical activities assists learning (Asheela et al., 2021; Shinana et al., 2021).

Mathematics offered me the opportunity to use many practical activities that I did with my learners during my teaching time. During such activities, I was able to identify learners who were struggling. For those learners, I would give the exercises relevant to their understanding.When I became Head of Department (HOD) in the FP, I developed a strategy that would easethe planning of lessons as I had more responsibilities. The method also assisted other teachersin terms of their workload. For example, I suggested that each of us oversee a subject. That was the best idea I had ever had and teachers enjoyed working in that way. What I can say about that system is that teachers were open to allowing those with expertise in particular topicsto come and teach in their classrooms. The sharing of knowledge created a space for solid collegiality and a community of practice.

In 2015, I started to work as a facilitator and a lecturer for in-service teachers for the RUMEP. There, I had an opportunity to work with schools in the rural areas of the former Transkei in assisting the teachers with teaching strategies and how to deal with challenging topics in FP Mathematics. That is the space that actually triggered my interest to consider researching DI. That is, my experience with the teachers in the most rural areas in the former Transkei was theimpetus for my study.

In 2018, I joined the Department of Education lecturing on FP Mathematics education. Here, my wanting to research DI was enhanced. First, I wanted to do action research working with the pre-service students but that did not work out well and I then changed to doing a case studyworking with schools.

1.4 My Positionality and Reflexivity

Positionality refers to the researcher's position concerning the participants within the social context of the study (Coghlan & Brydon-Miller, 2014). In addition, Holmes (2020) points outthat positionality defines both an individual's view of their world and the position that the individual assumes about a research project. The individual's views can be beliefs about socialreality such as

culture, ethnicity and gender, whereas position can be marital status and teachingexperience. All these aspects can affect how research is performed either positively ornegatively. Holmes (2020) further accentuates that positionality replicates the opinion that theresearcher has chosen to adopt within a given research study.

During this study, I was aware that my position as a university lecturer might affect the participants because of my professional identity. Also, one of the participants was a young male who was my former student. I was thus conscious of the potential power relations betweenthe participants and me as I was a lecturer who came from outside the social group participatingin the study. Therefore, I had to make the participants feel at ease with my presence. I made them aware that they had the experience and might be implementing DI in their classrooms even though they may have been calling it by a different name, since I left teaching some timeago. I thus clearly explained the purpose of the study.

Moreover, in addressing the matter of positionality, I endeavoured to ensure that I honoured and respected all the participants, helping them understand that they were *co*-producers of knowledge in this study. I also ensured that I followed their schedules for my visits to the respective classrooms and did not overstep their boundaries. Clift et al. (2018) acknowledges that positionality in research requires the researcher to create a common ground. I did not wantmy participants to perceive me as an intruder in their space; to this end, I ensured and maintained the status that I was a learner in the process and that they were the experts (Woods, 2019) or more knowledgeable others as espoused by Vygotsky (1978).

Dodgson (2019) avers that all qualitative research is contextual, meaning it happens within a specific time, place and with specific people. Self-reflection and a reflexive approach are botha requirement and a continuing process for the researcher to identify their positionality (Cohenet al., 2018). Cohen et al. (2018) further acknowledges that reflexivity is the concept researchers should use to recognise and reveal themselves. Positionality, therefore, refers to theresearcher's position concerning the participants within the social context of the study (Coghlan & Brydon-Miller, 2014).

It is vital to have the ability to be reflexive during the process of conducting research and analysing (Holland, 1999). Reflexivity is where researchers are involved in an explicit, self- aware analysis of their own role in the research (Finlay, 2002). This means being thoughtful about how relations

of power operate in the research process (Reid et al., 2017). For the purposeof this research, I made sure that I did not become biased.

Reflexivity starts by recognising the researcher's biases in the project (Holmes, 2020). As a qualitative researcher, I was part of the research; therefore, I needed to be mindful of my prior experiences and assumptions so that they did not influence the research process. Favouritism could be based on my values and life experiences.

Reflexivity is essential in qualitative research because this domain depends on information that participants provide in the study. I also needed to adapt according to the situations I came across in my research. For instance, I had planned to have face-to-face interviews but becauseof Covid-19, I had to change the plan. I collected data from an online forum which was a Zoom meeting to adapt to the new situation. This change did not affect my feelings and I was very welcoming.

1.5 Statement of the Problem

One-size-fits-all instructional strategies do not effectively serve learners, thus the use of DI is needed (Tomlinson, 2000). Sibanda (2021) has acknowledged that while DI is not well known,it is effective when teaching Mathematics in the FP. It is a teaching philosophy set up to help teachers differentiate instruction to best suit all learners' needs and help them succeed to theirhighest potential (Tomlinson, 2000). However, differentiation in the classroom is perceived asa challenge for teachers because they might not understand how to differentiate well. Also, some may have limited knowledge of differentiation as they are not familiar with DI conceptsand are not well trained in implementing it.

That is partly exacerbated because the teaching profession is highly challenging and involves several necessary duties that teachers must do. These additional daily duties make some teachers feel overwhelmed and it becomes more complicated to integrate DI into their existinginstructional strategies. These instructional strategies for DI are creating learning centres, developing interest groups and identifying challenging instructions for learners whereby the teacher becomes aware of the learners' learning styles The planning and implementing of DI needs a lot of hard work and willpower. It is recognised that older teachers, many of whom were trained years ago, may be unfamiliar and find it hard to follow the newer instructional strategies. It is against this background that I sought in this study to examine how teachers implement DI.

1.6 Purpose and Significance of the Study

This case study examined how Grade 3 FP Mathematics teachers implemented DI in their classrooms. According to Weimer (2013), when the DI method is used in teachers' education, learners' learning is improved by providing various ways to obtain knowledge or new information. The significance of the study was to observe if teachers created a space for DI.

Quality teaching practices are meant to be responsive to the differential needs of all learners, and this is the reason that I decided to do the study. Thus, the study also sought to find out what challenges teachers face in implementing DI when teaching mathematics. Then, the study looked at how DI teaching practices were made visible through the lens of the Theory of Practice Architecture (ToPA) (Edward-Groves, 2018).

1.7 Research Goal, Objectives and Research Questions

The overarching goal of this study was to examine teachers' understandings and pedagogical insights on teaching mathematics using DI in Grade 3 classes in different schools in Makhanda.To achieve this goal, the following objectives and research questions were addressed.

1.7.1 Research objectives

The research objectives were to explore:

1. Foundation Phase teachers implementation of differentiated instruction when teaching mathematics to their Grade 3 learners.
2. Differentiated instruction being made visible through the lens of the Theory of Practice Architectures.
3. Strategies that Foundation Phase teachers use when implementing differentiated instruction in their mathematics classrooms.

1.7.2 Research questions

1. How do Foundation Phase teachers implement differentiated instruction when teaching mathematics to their Grade 3 learners?
2. How are the differentiated teaching practices made visible through the lens of the Theory of Practice Architectures?
3. What strategies do Foundation Phase teachers use when implementing differentiated instruction in their mathematics classrooms?

1.8 Literature Review and Theoretical Framework

I this section, I briefly discuss the literature review and the theoretical framework used in this thesis.

1.8.1 Literature review

The phenomenon under study was the implementation of DI when teaching Mathematics in Grade 3. The conceptual framework sets up the platform for presenting the research question. This framework was the vehicle for my study. This study examined DI, with this being the keyconcept underpinning this study, within Grade 3 Mathematics classes.

1.8.2 Theoretical framework

This study used the ToPA to explore DI practices in the classroom situation. The ToPA is a practice theory that focuses on social life (Edward-Groves, 2018) and was chosen for this study because it provided a lens to examine and evaluate practices. According to Mahon et al. (2017), there are three intertwined arrangements in the theory of practice: cultural-discursive, material-economic and social-political.

1.9 Data Gathering Methods

Data collection is a vital aspect of any research. The use of more than one data collection technique to answer the research questions in qualitative research is called triangulation (Burns& Grove, 2001). Accurate data collection is essential in maintaining research integrity becausethe findings and conclusions of a study are constructed on what the data revealed. In this study,I thus used observations and semi-structured interviews to gather my data.

Regarding observations, I used naturalistic observation for my study. With this type of observation, I observed behaviours in their natural contexts, which allowed me to study the actions of the participants if and when they implemented DI in their classrooms.

I also conducted semi-structured face-to-face interviews which allowed me to study the participants' body language and make a reliable judgment about whether further probing was necessary. During the interviews, I followed COVID-19 protocols. Thus, I did one of the interviews via Zoom since the participant was not feeling well.

1.10 Definitions of Key Concepts

Case Study: Explores cause-effect relationships and how events happen (Baxter & Jack, 2008).

Differentiated Instruction: A teaching philosophy based on the premise that teachers should adapt instruction to learner differences (Tomlinson, 1999).

Grounded Theory: This is an in-depth, detailed examination of a particular case (or cases) within a real-world context (Creswell, 2014).

Explanatory Case Study: This explores cause-effect relationships and how events happen (Yin, 2014).

Interpretivism: This is about how we can gain knowledge of the world (Cohen et al., 2018).

Mainstream schooling: A policy or system of segregation or discrimination based on race (Pillay & Di Terlizzi, 2009).

One-size-fits-all: Learners are subjected to the same teaching styles and evaluation methods irrespective of their ability or interest (Bondie et al., 2019).

Paradigm: A way of looking at something (Creswell, 2016).

Positivism: A belief that reality is out there to be studied and understood (Burns, 2000).

1.11 Thesis Outline

The thesis consists of six chapters and I describe these below.

Chapter One: This chapter communicated the aim and focus of the study and the backgroundof the study. The chapter reflected on my personal experiences where I situated myself. Then it further described the purpose and the significance of the study. In addition, the first chapter explained the research aims and objectives and the research structure.

Chapter Two: This chapter discusses the literature relevant to this study. I start by looking atthe history of IE internationally and in a South African context. Further, the chapter discussesthe importance of IE in enabling teachers to use DI in their teaching and the DI concepts are clearly explained. There is also a clear account of the advantages and disadvantages of DI. Lastly, the chapter discusses how DI fits into inclusive practices. The chapter explains the ToPA and different practices in the theoretical framework. The chapter explores the three practices in the social world that hang together. These practices are interwoven with each otherand are a product of a practice architecture consisting of semantic (e.g., cultural-discursive), social (e.g., social-political) and physical (e.g., material-economic) arrangements. The study clearly explains these arrangements regarding how they have been tailored.

Chapter Three: In this chapter, I present the research methodology used in this study and the research paradigm and research design used. The case study approach, the research goal, research questions, site, participants, and sampling are discussed. Further, the chapter discusses the explanatory and qualitative research viewpoints used in this study. It further shows why the case study method was chosen to investigate how teachers implement DI in a Grade 3 Mathematics class.

Chapter Four: This chapter presents, analyses, interprets and discusses the data collected using observations.

Chapter Five: This chapter presents, analyses, interprets and discusses data collected using the semi-structured interviews.

Chapter Six: This chapter discusses the summary of findings, recommendations, the conclusions and the study's limitations. It also highlights areas for future research.

1.12 Chapter Summary

The chapter has subsequently described the aims of the present study and provided a chapter- by-chapter overview of the thesis. Differentiated instruction (DI) is meant to assist teachers in planning effectively to meet the diverse needs of learners in today's classrooms to achieve specific standards. Rather than a set of tools, differentiation is a belief system that teachers embrace to meet every learner's unique needs (Tomlinson, 2000). This chapter has thus introduced the research area and outlined the background and motivation for the present study.It provided a brief

overview of the research focus or problem and explained why it was worth conducting. Background information about my personal experiences and positionality were discussed. This chapter has also briefly highlighted the literature relevant in this study, data gathering methods and definitions of concepts that appear in the thesis.

CHAPTER TWO: LITERATURE REVIEW & THEORETICAL FRAMEWORK

2.1 Introduction

This chapter discusses the literature that is relevant to the study. I start by looking at the historyof IE internationally and in the South African context. Further, the chapter discusses the importance of IE in enabling teachers to use DI in their teaching. The context and explanationfor my review of the literature on DI – which served as my conceptual framework – are presented in this chapter.

The literature review in this study assisted me to build knowledge in the field that I was investigating. Thus, the use of a literature review in the study allowed me to explain important concepts, essentially, looking at how these concepts are applied in real-world situations. Therefore, the literature review helped me in refine, focus and shape my research questions aswell as develop a theoretical and conceptual framework (Lysaght, 2011). Included in my discussion is the ToPA as my theoretical framework. The theoretical framework served as a structure and support for the rationale for the study. Therefore, the theoretical framework in this study was used to make sense and give meaning to what is contained in my data (Nelson, 2017) and enabled me to report my findings in an analytical and creative way. The theoreticalframework provided an anchor for the literature review. The last part of the chapter provides aclearly defined summary.

2.2 Inclusive Education in South Africa

Globally, education is seen as a human right (United Nations Educational, Scientific and Cultural Organization [UNESCO], 2020). Thus, an agreement was established that all childrenhave the right to education which includes those who have special needs (UNESCO, 2020). ToUNESCO, education is a priority and instituted an education 2030 framework action agenda which forms part of the movement to eradicate poverty through the 17 sustainable goals. Fromthese 17 goals, goal 4 aims to “ensure inclusive and equitable quality education and promote lifelong learning opportunities for all”. Meanwhile, even though most countries still have

various types of separate special provisions for some students, South Africa on the other handhas developed an IE policy in order to address barriers to learning in the education system. The framework for an IE system is set out in the Education White Paper 6: Special NeedsEducation: Building an Inclusive Education and Training System (DoE, 2001). Since IE is being described as a possible answer for responding to diversity in education, it is considered worthwhile to explore the underlying basis for IE (Oswald, 2014). Thus, in this study inclusivity in the mainstream classroom is discussed.

South Africa's IE policy is strengthened by the South African Constitution Act 108 of 1996. A change in the nature of political dispensation brought in a new constitution which needed to change the system from an excluding society to an inclusive society. Thus, it requires teachersto implement IE. It is acknowledged, however, that in order for teachers to be able to successfully execute IE, they need to receive proper support with the necessary requirements so that they are ready to accept learners with different learning needs (Avramidis et al., 2000).

Globally, there is a move towards IE. This is the view that all learners are able to learn including those with special needs in mainstream schools (Onyishi & Sefotho, 2020). When children with special needs are included in mainstream schools, the classroom becomes more diverse (Blackman, 2022). Clark et al. (2018) note that mainstream schools should transform in order to make IE successful. Additionally, Michailakis and Reich (2009) validate that IE strives to educate people with intellectual disabilities by incorporating them as much as possible into thenormal structures of the educational system. Further, Booth and Ainscow (2011, p. 9) aver that "inclusion is based on high level of involvement of learners". In addition, intellectually giftedlearners also need to be catered to within the regular classroom (Chani et al., 2018). That is, learning should be mediated by providing enrichment activities to meet the needs of gifted learners.

Before focusing on IE, South Africa first had to move towards democracy. For instance, the post-apartheid regime through the South African constitution assured that everyone has the right to basic education. This resulted in the SASA 84 of 1996 which also enforced the right tobasic education (DoE, 1996). Thus, a new era in education was ushered in by this act. It embodied the principles reflected in the constitution and the White Paper on education and training that followed.

In 2001, Education White Paper 6 (WP6) was established to build an IE and training system (DoE, 2001). Based on the WP6 (2001) there is a need to transform the entire education systemso that barriers to learning can be removed (DoE, 2001). Moreover, the WP6 recognised that all children and youth can learn, all children require support that education should be enabledto meet the needs of all learners, and that differences in learners should be respected while building on their commonalities (DoE, 2001). In other words, this signifies that learners who were ignored in the previous system due to learning challenges, would now be incorporated and educated in the mainstream school. This means that currently, teachers are increasingly confronted with the needs of all learners, including those with special educational needs (SEN)in mainstream classrooms. The White Paper 6 also differentiates between mainstreaming and inclusion. Table 2.1 describes the differences between mainstreaming and inclusion.

Table 2.1: Shows the differences between mainstreaming and inclusion

Mainstreaming or Integration	**Inclusion**
Mainstreaming is about getting learners to 'fit into' a particular kind of system or integrating them into this existing system.	Inclusion is about recognising and respecting the differences among all learners and building on the similarities.
Mainstreaming is about giving some learners additional support so that they can 'fit in' or be integrated into the 'normal' classroom routine. Learners are assessed by specialists who diagnose and prescribe technical interventions, such as the placement of learners in programmes.	
Mainstreaming and integration focus on changes that need to take place in learners so that they can 'fit in'. Here the focus is on the learner.	Inclusion focuses on overcoming barriers in the system that prevent it from meeting the full range of learning needs. The focus is on the adaptation of and support systems available in the classroom.

Source: Adapted from the DoE (2001, p. 17)

Above are important features for teachers to understand and distinguish between when makingIE a reality as these hold different views for classroom practice. According to the WP6 (2001),the principles of human rights and social justice for all learners are the basis of the system. Thepaper further notes that "participation, social integration and redress; equal and equitable access to education; community responsiveness; and cost-effectiveness" (DoE, 2001, p. 1). Thus, WP6

acknowledges the fact that different people have different learning requirements that are equally valued for the entire human experience.

Therefore, in order for the learner to be part of the IE system, a shift in the curriculum should occur (Ainscow, 2005). Ainscow (2005) further states that the learner is no longer expected tofit into the classroom but the classroom should be transformed to meet the learners' educational requirements. To make the class more transformed, the South African curriculum has been changed to integrate the principle of IE (DoE, 2001). This means that the curriculum execution should be flexible with regard to teaching approaches (DoE, 2001). However, challenges to executing IE remain patent due to the combination of a lack of resources and the attitudes and actions of the teachers in the classroom (Engelbrecht et al., 2015). Also, the current Curriculumand Assessment Policy Statements (CAPS) document does not respond to the requirements ofa flexible curriculum as stated in the WP6 (DoE, 2001). Resultantly, when this practice has tobe implemented, teachers have to be equipped as they are the primary resource for realising thegoal of an IE system. Included in the policy was the process of "Screening, Identification, Assessment and Support (SIAS)".

The process is as follows: Screening is guided by the learnerprofile. This is done at the beginning of each phase where the teacher captures the learner's record. The information captured in these areas may indicate possible barriers to learning. This allows the teacher to gain better understanding of the barriers to learning that the child is having. After the learner has been identified through the initial screening as being vulnerable or at risk, the teacher completes the Support Needs Assessment 1 (SNA1) form. Then the teacher completes the SNA2 form that gives guidance on the support that will be given to the learner. This process assists teachers to discover the learner's barriers so that they can be assisted with them. However, administration of these processes to establish an accessible educational framework for learners seems to remain a challenge (Majoko et al., 2018).

The challenge is that schools are not equipped with resources and facilities required to enhance theneeds of inclusion. Even though IE remains a challenge, inclusive schooling is strengthened by DI as it enables learners to access the full range of resources in mainstream education. Another point is that diversity in the classroom in terms of learning styles has also revealed the need for teachers to rethink relevant instructional strategies and practices that will enable them to teach every child (Onyishi & Sefotho, 2020).

The presence of diverse learners with different intelligences, abilities and disabilities, interests,and learning styles has shown the need for teachers to reconsider applicable instructional strategies and practices that will enable them to meet the needs of the diverse learners (Heacox,2012; Subban, 2006; Suprayogi et al., 2017). This places an increased responsibility on the teacher who has to diversify instructional content, methods, materials and assessment strategiesthrough the use of DI to accommodate all learners and help them maximise their potentials.

2.3 What is Differentiated Instruction?

Differentiated instruction (DI) is seen as a vital yet complicated skill for teaching (Tomlinson & McTighe, 2006) and is an attempt to reach all learners. A body of studies has been written showing support for the awareness of DI. Further, policy designers and researchers advise teachers to incorporate diversity. Several developments encourage the need for DI. The DoE has developed documents that encourage IE. These are the WP6 and the Guidelinesfor Responding to Learner Diversity in the Classroom through the CAPS document. Differentiated instruction (DI) is well known; however, teachers seem to struggle to understandhow it should be employed. Thus, this chapter explores the use of DI in the FP. It also exploreshow DI is used through content, processes, products and the learning environment (Tomlinson,1999). Furthermore, this chapter examines how content, processes and development should be grounded upon the learners' strengths, needs and learning styles where learners' readiness, interests and learning profiles are considered (Tomlinson, 2001).

The focus of this study was the implementation of DI when teaching Mathematics in Grade 3.This study examined DI practices within Grade 3 Mathematics classes. Mathematics was the driving mechanism/tool to understand DI concepts better. Therefore, mathematics is secondaryto the overarching concepts of DI.

Differentiated instruction (DI) is a philosophy that recognises that learners learn in diverse ways and at different paces (Tomlinson, 2005). Thus, DI responds to the differences among learners in the classroom (Strogilos, 2018). Essentially, DI involves finding various methods to develop a lesson so that each learner can work at a suitably challenging level that enables them to be included. In this regard, DI requires teachers to be flexible in their instructional strategies, adapt the curriculum and present subject information to learners (Tomlinson, 2014).The adaptation of the curriculum suggests that DI is not a single strategy but rather an approachto instruction that combines a variety of techniques. In my study, teachers must proactively modify curricula,

teaching methods, resources and learning activities to differentiate lessons successfully. In putting DI strategies into practice, teachers seek to meet the diverse needs of individual learners in small groups of learners to maximise learning opportunities for each learner in the classroom.

Admittedly, learners are different in many ways. For instance, some differences will be cognitive and some relate to learning styles and preferences, including behaviours and personalinterests (Small & Lin, 2010). Such differences require teachers to create differentiated, personalised or responsive classrooms. In this regard, Suprayogi and Valcke (2016) explain that most authors share the five dimensions that state that DI accommodates the diversity of learners by (i) coping with learner diversity (ii) adopting specific teaching approaches (iii) using variety in learning activities (iv) keeping a good eye on learner needs and (v) following best learning outcomes.

According to Tomlinson and Allen (2000), DI is based on modifying four elements: content, processes, products and affect/learning environments, which influence classroom instruction. This modified teaching strategy is guided by the teacher's understanding of learners' needs considering that they can be the same age but differ in their traits, including readiness, interestsand learning profiles (Tomlinson, 2013). These traits will be unpacked further in this section. Teachers who differentiate instruction recognise and acknowledge these differences. For instance, Figure 2.1 below illustrates four elements in which the teacher can practice differentiation in the classroom.

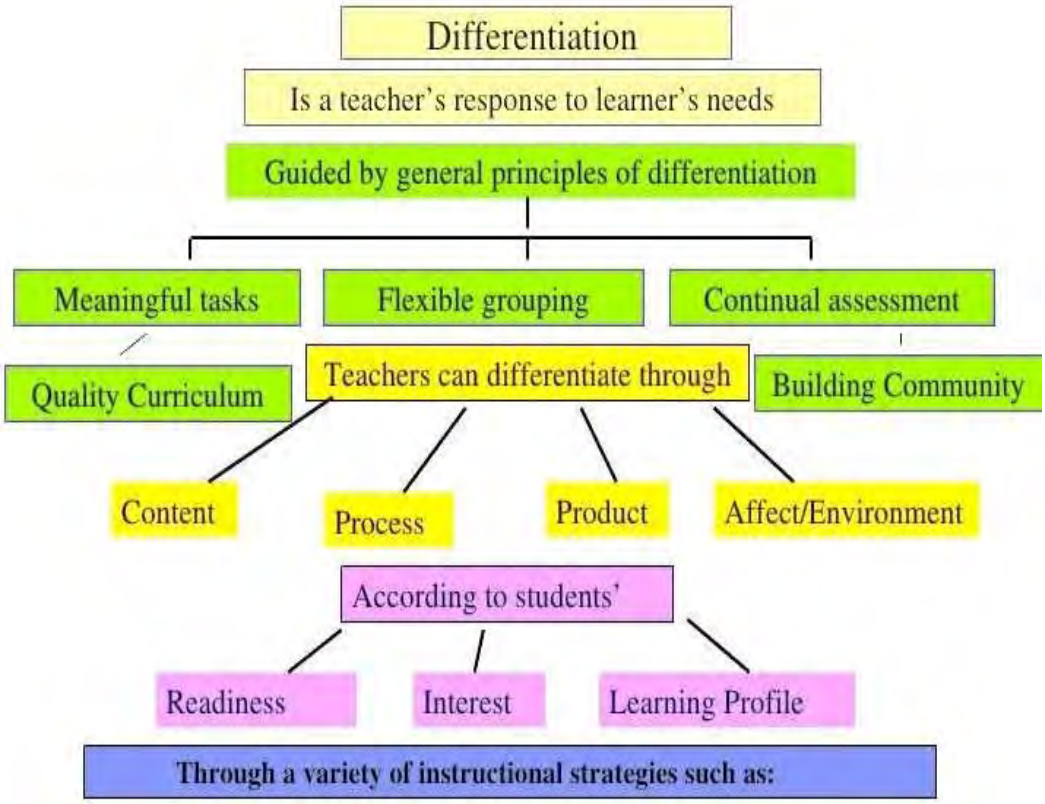

Figure 2.1: Differentiated instruction model
(https://educ4720sylviakas.weebly.com/definitions/what-is-differentiation)

What is most likely to change in a differentiated classroom is how the teacher enables learnersto access knowledge and skills (Tomlinson & Allen, 2000). As alluded to earlier, teachers differentiate through content, processes, products and environments. Content is the informationthat the learners must learn based on the curriculum (Tomlinson & Allen, 2000). Differentiatingthrough content relates to what the teachers teach. The teacher plans activities for individuals or groups of learners that cover different difficulty levels. The content consists of facts, concepts, generalisations or principles, attitudes, skills related to the subject and materials representing those elements (Tomlinson & Imbeau, 2010).

In assisting learners in learning, the content is adjusted to meet the different needs of learners and the level at which they are learning mathematics (Tomlinson, 2001). This does not necessarily mean that such mathematics is different from the prescribed curriculum but instead is presented in a manner that is more accessible for the learners. In addition, Hall (2002) advocate the view that DI is a process by which teachers adjust learning that enables them to

match the learner's learning traits. Teachers use DI to promote/encourage and facilitate learning for diverse learners.

The process relates to how the teachers impart the information to make sense of the content. The teacher enables learning (Tomlinson & Allan, 2000). Concurring, Blaz (2016) suggests that the differentiating process refers to how the teacher plans instruction and how learners make meaning of instruction. Therefore, the process is how learners are allowed to interpret the content and ideas outlined in the curriculum (Tomlinson & Allan, 2000). The process offerslearners an opportunity to perform new skills at the right level of understanding in a mathematics class. It can also be done through tiered activities. All learners are working with the same information, experience and knowledge but will advance with different levels of support, challenges or complexity (Chamberlin & Powers, 2010).

In a tiered activity, work is planned so that learners with different understandings of a topic can work simultaneously. The result is sequenced so that learners are moved through their zones of proximal development (Vygotsky, 1978). The following are examples of tiered activities. A tiered one activity can be done using concrete apparatus in a lesson where learnersdo addition. In tier two, the activity can be done using visuals and then a tier three activity canbe word sums. When teachers differentiate through the processes, it is based on the content. Here, teachers allow learners to use their inquisitive minds to try out new things. Below is an example of a tiered activity.

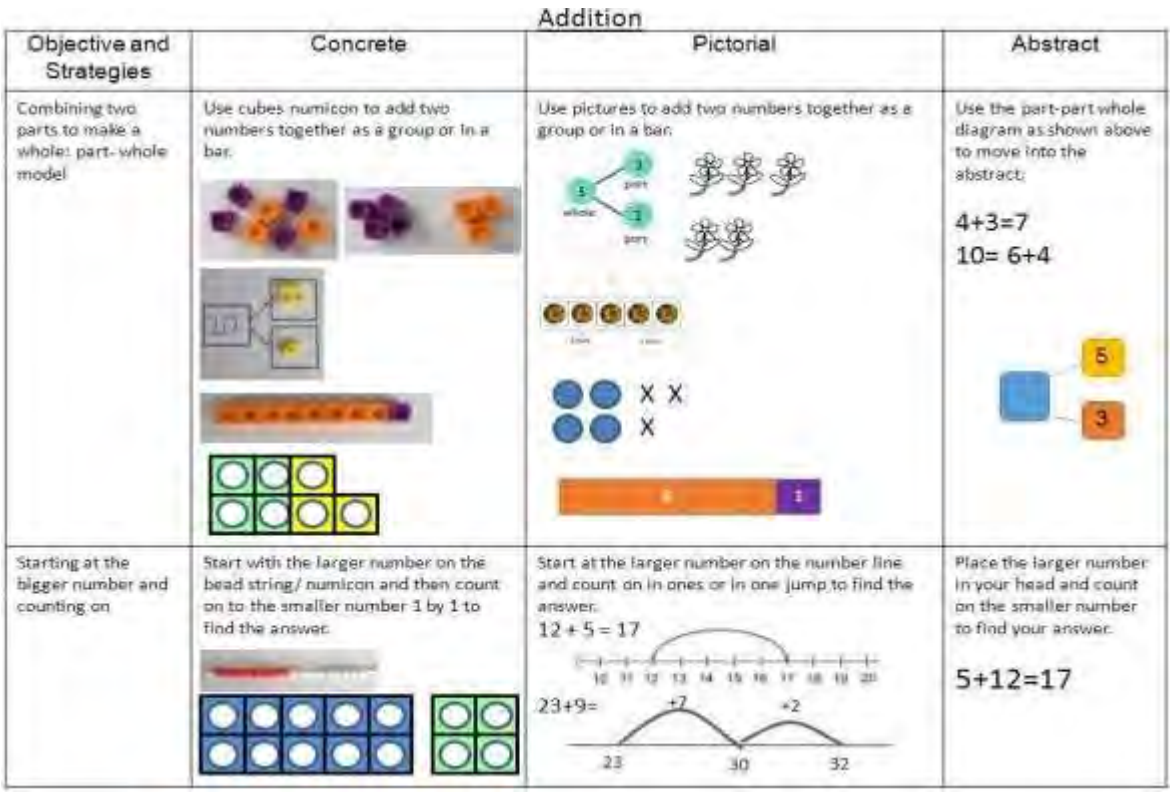

Figure 2.2: Tiered activity on addition (https://slidetodoc.com/objective-and-strategies-combining-two-parts-to-make/)

The concept of 'product' refers to how learners may "demonstrate what they have come to know, understand, and do after an extended period of learning" (Tomlinson & Imbeau, 2010, p. 15). And so, the product is closely associated with assessment methods where the learners can show how much they have understood and learnt. Product is used to evaluate and assess alearner's understanding of the content (Lazarus, 2011). Furthermore, Lazarus (2011) avers thatlearners should be given several choices in demonstrating what they have learnt, such as simulated journal entries, puppet shows, peer projects or multimedia presentations. Thus, learners can be offered the choice to express the required learning based on their preferred learning styles.

The learning environment refers to the organisation and atmosphere of the classroom and the way the teacher has made the classroom conducive to learning (Tomlinson, 1999). Tomlinson(1999) emphasises that without an effective learning environment with rules, procedures and respect for others, differentiating content, processes and products might be more challenging to accomplish and may not result in the expected positive outcomes. A learning environment should also be conducive to meeting learners' emotional needs. A flexible classroom layout isvital, incorporating

various furniture and classroom arrangements to support both individual and group work (Tomlinson & Allan, 2000). At the heart of DI lies flexible grouping. Flexiblegrouping offers opportunities for learners to be part of different groups (Tomlinson, 2001). Therefore, FP teachers strive to create a good learning atmosphere that supports other learningskills (Tomlinson & Moon, 2013). This modification is guided by the teacher's understandingof learners' needs, considering that they can be at the same age but can respond differently to learning through the three characteristics: readiness, interests and learning profiles.

Considering content, processes, products and environments, teachers have to consider the three characteristics as the focal point in DI practices for learning to occur. This means that the teachers should tailor instruction according to the three characteristics to meet individual needs.Teachers differentiate content, processes, products and the environment according to learners'readiness, interest and learning profiles as learners learn much better when the teacher offers those activities that match these characteristics (Tomlinson, 2017).

Learner readiness denotes a learner's proximity to the required learning outcome (Tomlinson & Imbeau, 2010). This refers to the skills level and background knowledge that the learner has.For the teacher to determine the learner's readiness, a baseline assessment is used to check what learners already know. Thus, considering a learner's prior knowledge is essential (Wetzels et al., 2011). To Tomlinson and Imbeau (2010), readiness assists in bridging the gapbetween what is known and what is not known. In this regard, Tomlinson (2001) posits that readiness determines what learners know and where they are in their learning at that particularpoint. However, more assistance and support for practice are required for learners with lower readiness (Tomlinson, 1999). Thus, the support to bridge the knowledge gap can be done by using a variety of books on a particular topic, offering a chance for ample opportunity beyond the curriculum and using visuals and manipulatives to show development. Tomlinson (2001) further notes that different learners show interest in various vital topics throughout the learningprocess. When the learner becomes curious and tends to pay attention to a topic, the learner is interested in the topic (Tomlinson & Imbeau, 2010).

When a learner draws attention to a topic and content at any given time, this is referred to as the learner's interest. This is made possible by connecting learners to real-life situations. It is also essential to allow learners to explore topics (Lipstein & Renninger, 2007). The aim of differentiating instruction according to interest is to assist learners to engage with newinformation,

understanding and skills by making connections with things they already find attractive, fascinating, relevant and worthwhile (Tomlinson & Imbeau, 2010). Tomlinson and Moon (2013) posit that learners' interests are determined by how teachers involve their interests when differentiating instruction.

Teachers must be creative when planning lessons to stimulate learners' interests. It also meansthat teachers need to have a deep knowledge of their learners (Tomlinson, 2001). Creative planning can include activities such as using cooperative learning approaches. Johnson and Johnson (1999) define cooperative learning as a learner-centred and instructor-facilitated instructional strategy in which a small group of learners is responsible for their learning. Theselearning approaches include processes (Tomlinson, 2001). Interest contributes to learners' self-confidence and eagerness to learn challenging work (Tomlison, 2013). When learners are interested in a topic, they feel at ease, are relaxed and more likely to learn more about it.

Differentiating through learning profiles relates to how learners process what they need to learnin the best possible way (Subban, 2006). Each learner has a way they prefer to learn (Tomlinson, 2001). Tomlinson and Imbeau (2010) further contend that four components help form a learning profile. These are intelligence preferences, gender, culture and learning style. Gardner (2000), in his recent work, describes nine learning styles. These are verbal-linguistic,logical-mathematical, bodily-kinesthetic, interpersonal, intrapersonal, musical-rhythmic, spatial, naturalist and existential intelligence. Naomi (2018) asserts that gender refers to procedures for learning that may be designed genetically or socially for males versus females.

According to De Vita (2001), culture signifies approaches to learning that may be firmly shapedby the environment in which individuals live and by the exclusive way people in that environment make sense of and live their lives. Learning styles signify a chosen contextual approach to learning (Bouzenada et al., 2014). Awla (2014) further explains that learning stylescan be visual. Learners learn by seeing pictures, diagrams, PowerPoint, notes, maps and graphic organisers. Auditory learners learn by hearing – these learners like reading aloud, listening to music and so on. The tactile-kinesthetic learner learns by actively moving around

and doing ‘hands-on’ activities which include play and games. Learning through play is essential because it helps learners understand the topic clearly (Kukey et al., 2019). In summary, DI is a teacher’s response to the learners’ needs through content, processes, productsand environments, bearing in mind that learners’ readiness, interests and profiles should be considered for each curriculum element.

2.4 Differentiated Instruction in Practice and Challenges

Differentiation in mathematics is the notion of providing adapted mathematics instruction to learners (Deunk et al., 2015). Play, games and music are other forms of assisting learners to learn mathematics in a different way (Russo et al., 2018). According to Pintér (2010), playing mathematical games permits an engaging way of developing mathematics skills. Concurring, Buchheister et al. (2017) further affirm that presenting and linking a number of ways of illustration during the context of playing games allows learners to use their specific learning preferences. Putting down the worksheets and moving away from the chalkboard is necessaryfor a different way of teaching mathematics. This can be done by exploring modern teaching methods such as learner-centredness. This method also supports learners in developing mathematical reasoning (Kaplar et al., 2022).

Such an approach requires teachers to have a variety of skills as well as a sound knowledge of mathematics content (Umugiraneza et al., 2017). This will assist teacher to be able to use DI when teaching mathematics. It seems that Strogilos (2018) is a supporter of DI, however, he acknowledges that there is inconsistent use of this model. Hence, he provides the following example to explain the lack of consistent use of DI – the lack of content knowledge to differentiate the curriculum, particularly for gifted children and learners with special educationneeds (LSEN). He thus avers that another impeding factor relates to time constraints to implement DI effectively. Like Strogilos (2018), Maulana et al. (2020) have also noted that DIis not easy to implement. For instance, according to Maulana et al. (2020), teachers who havegood classroom management and clearly explain the planned activities to the learners can differentiate based on Tomlinson’s model of DI. In their findings, Maulana et al. (2020) showedthat South Korean teachers seemed to be more skilled in DI than Dutch teachers.

Munro (2012) also highlights some challenges associated with DI. These challenges are lack of the content knowledge needed, lack of pedagogical knowledge and lack of the classroom management skills to support differentiated teaching. Munro (2012) further claims that it becomes

a challenge when the teacher does not know how to accommodate the learning approaches to enable gifted learners to learn. Sometimes teachers are not supported by the school management team because the team lacks knowledge of DI (Blecker & Boakes, 2010).Van Tassel-Baska and Stambaugh (2005) also identified the issue of the lack of differentiationbetween gifted and talented learners in regular classrooms. According to these scholars, this was due to a lack of professional knowledge in a school about understanding gifted learning and the associated pedagogy and relevant curriculum. Moreover, teachers often seem not keento participate in collective curriculum decision-making and work with other teachers (Wan, 2017).

2.5 How Does Differentiated Instruction Fit into the Domain of InclusivePractices?

In the above section, I have outlined the concepts related to DI. However, exploring what other researchers say about inclusion and diversity concerning DI instructional practices is also necessary. When South Africa attained its democracy in 1994, issues about the curriculum change and providing quality education to all learners became important (Gwalla-Ogisi et al., 2006). That resulted in the entire education system being revamped; for instance, the development of the EWP6 came to life (DoE, 2001).

The EWP6 was developed to assist teachers in building an ID and training system. Therefore,an IE system was embraced where all learners could learn together within a system of supportthat talks about not only disability but also a variety of barriers to learning resulting from poverty, inequality and other social conditions (DoE, 2001). In this study, IE is defined as including teachers using DI for teaching practices. Strogilos (2018) notes that inclusion involves developing procedures that assist in acknowledging learners' socio-cultural backgrounds to allow all learners to participate in learning (Mavuru & Ramnarain, 2020; Vygotsky, 1978). In this study, inclusion is not meant for or focused on special schools but formainstream classrooms (Gilbert & Rajan, 2014). In addition, the DoE (2001) advocates that inclusion should be done not only in special schools but also in mainstream schools. Thus, the DoE has a policy document called "Responding to diversity in Grades R to 9". Such a document is meant to assist teachers in implementing DI in all subjects.

For instance, in the mainstream classroom, inclusive practice can be explained as means and ways that ensure all learners can access education (Wang, 2009). According to Engelbrecht et al. (2015), IE has been a commonly adopted model for education. This suggests that inclusionshould happen in a familiar learning setting to offer support and reduce learning barriers that may lead to

exclusion. When inclusion happens, teachers must create educational spaces that promote stimulating teaching and learning processes (Lindner & Schwab, 2020). Moreover, teachers should be aware of issues relating to diversity among learners (Ferrante, 2012). This includes many different factors such as race, ethnicity, gender, sexual orientation, socioeconomicstatus, ability, age, religious belief or political conviction. These factors inform how learners encounter the world (Ferrante, 2012).

The two concepts, inclusion and diversity, are significant to this study because they might assist educators in creating a safe and collaborative learning environment. Above all, effective IE takes place mainly through accepting, understanding and attending to learner differences. Diversity can be of an intrinsic or extrinsic nature[4]. Sadly, South Africa is positioned as the worst country in teaching mathematics (Taylor, 2021). For learners to perform better, there is a need for competent mathematics teachers who will be able to respond to different learning conditions in the classroom. However, for teachers to meet these conditions, DI is an ideal model to support all learners (Marishane et al., 2015).

As alluded to earlier, DI is a principle through which teachers enhance learning by matching learners' characteristics to instruction and assessment (Tomlinson & McTighe, 2006). Marishane et al. (2015) further attest that for teachers to do DI, they need to understand the curriculum's background. Ball et al. (2005) assert that for the teachers to implement teaching using DI, they need to have a good content knowledge for teaching mathematics. Knowing thecontent alone is insufficient – the teachers also need pedagogical content knowledge (Charalambous et al., 2020; Shulman, 1986).

Learners in the same mathematics classroom show diversity in how they follow instructions. This means that the teacher should reach the learners' needs by using DI (Tomlinson, 2001). When using DI in a mathematics class, the teacher allows learners to respond to a task differently. The teacher can provide different strategies while working with the same mathematics problem (Tomlinson, 2013). These different strategies can be done by having learners work in groups, games, singing, drawing and using manipulatives. In this way, teachers promote each learner's

[4] Intrinsic**,** coming from within. The most prominent intrinsic factors are physical and/or physiological impairments and personality characteristics which are caused by many factors. Extrinsic, originating from something external. Socioeconomic barriers, discriminating attitudes, poverty, educational/systemic barriers, lack of resources and so forth.

strengths and mathematical skills to build a more robust learning community (Subban, 2006).

2.6 Theoretical Framework: Theory of Practice Architectures

A theoretical framework is imperative in the process of doing research. It gives guidance and direction to the study. Similar to this statement, Grant and Osanloo (2014) state that a theoretical framework structure establishes that all information is developed. In this regard, Raj (2014) posits that a theoretical framework applies a theory or a collection of ideas drawn froma theory to offer evidence of an occurrence. In addition, Adom et al. (2018, p. 438) assert thata "theoretical framework explains the path of a research and grounds it firmly in theoretical constructs". This means that a theoretical framework is generally drawn from a particular theory. In the case of my study, the theoretical framework was drawn from practice and practicearchitecture theory.

There are numerous kinds of practice theories. Schatzki (2012) notes that practice theory has gained popularity in recent years and thus suggests that practice has three significant commonalities. Firstly, practice is an organised constellation of different people's activities. Secondly, practice is a social phenomenon. In other words, it is not the activity of individuals but the organised activities done by several people (Vygotsky, 1999). Thirdly, practice is a human activity. Thus, Schatzki (2012) maintains that practice consists of *doings* and *sayings*. To Schatzki, *doings* refer to practice activities and physical actions, and *saying*s refer to practice's thinking, language and understandings.

Similarly to Schatzki, Kemmis (2013) agrees that practice is socially established. He argues that any social activity gives rise to relations of power and solidarity, and so, he included *relatings* as part of the practice. To Kemmis, *relatings* refer to how people relate to each otherand the material world during a practice (Mahon et al., 2016). Essentially, the term 'practice architectures' defines how practices are affected by various sets and contextual issues (Kemmis, 2012). This study explored practices in a social context established by activities involving attributes of understanding (*sayings*), modes of action (*doings*) and ways in which people relate to one another and the world (*relatings*) that hang together in a typical way (Kemmis et al., 2014; Rönnerman & Kemmis, 2016) as illustrated in Figure 2.3 below.

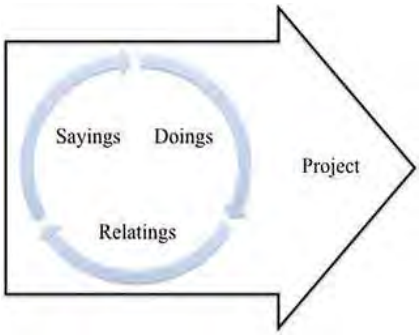

Figure 2.3: Practices diagram adapted from Kemmis et al. (2014b, p. 33)

Practices in the social world hang together through three attributes that are in existence. These three attributes appear to be interconnected (Edwards-Groves & Grootenboer, 2015) rather than disjointed. Hemmings et al. (2013) further define practice as arrangements of entities in three kinds of 'intersubjective' spaces; that is, spaces in which people encounter one another as interlocutors, in interactions and interrelationships. Ngcoza and Southwood (2019) proffer that space is regarded as an element of social relations and imagination. Furthermore, these scholars stipulate that space is not an isolated structure but a social experience. In this space, practices are shaped by "mediating preconditions, the cultural-discursive, material-economic, and social-political arrangements" (Kemmis, 2013, p. 538).

These preconditions are interwoven within each other. The cultural-discursive arrangements, for instance, give shape and content to the *thinking* and *sayings* that orient and justify the practice. The material-economic arrangements shape and provide content to the *doings* of the practice. The social-political arrangements shape and give content to the *relatings* of the practice (Kemmis, 2008). These arrangements are shaped by the practice's *doings, sayings* and*relatings* (Kemmis, 2013). According to this theory, practice is enabled and constrained by cultural-discursive, material-economic and social-political arrangements. This study used the ToPA to explore DI practices in the classroom.

The ToPA is one practice theory that focuses on social life and is situated within practice theory (Edward-Groves, 2018). The theory advocates that every practice presented in the classroom is a product of a practice architecture consisting of semantic (e.g. cultural-discursive), social (e.g. social-political) and physical (e.g. material-economic) factors (Kemmis, 2012). Thus, I used this theory to explore how teachers practice DI during their lessons in semantic space, physical space-

time and social-political space. By choosing this theory, I hoped that it would help me gain some insights into these teachers' practices. All these concepts are represented inthe following diagram (Figure 2.4) illustrating the ToPA.

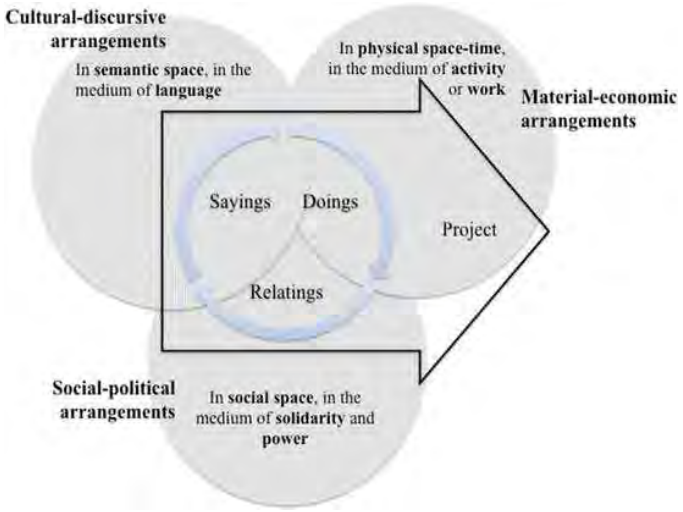

Figure 2.4: ToPA diagram (adapted from Kemmis et al., 2014, p. 34)

I now discuss each of these preconditions below.

2.6.1 Cultural-discursive arrangements

In semantic space, the *sayings* of our practices are entangled with cultural-discursive arrangements (in language and specialist discourses) that enable and constrain what we voice and how we think. The cultural-discursive arrangements can be achieved through language useto make the *sayings* of the practice possible. This statement refers to the terms used in mathematics lessons that align with DI in the classroom during teaching and learning. The study looked at how teachers use mathematics language, whether as an enabling or constrainingfactor (Rönnerman et al., 2017). The language of instruction used in the lessons was isiXhosa,the teacher's and learners' mother tongue. The *sayings* occurred in the medium of mathematics terminology, including specific concepts of the topic being taught (Kemmmis, 2016).

For this research, the *sayings* occurred when a teacher was teaching a mathematics concept andthe sayings were conditioned by isiXhosa language terminology. The arrangements also involved the use of the voice of the teacher during the lesson (Salamon et al., 2016). Hence, the language was encountered by the teacher and the learners and the learners amongst each other in the classroom. This occurred when the teacher put learners in groups. Thus, the studylooked at how the teachers related to these terms and concepts. The *sayings* also brought aboutthe ideas and understanding of

concepts when the learners expressed themselves to show theirknowledge of the content.

2.6.2 Material-economic arrangements

In a physical space-time, as alluded to earlier, the *doings* of our practices are entangled with material-economic arrangements (in the medium of activity and work) that enable and constrain where we can go and what we can do. The material-economic arrangements are understood in practice as the form of *doings* that the teacher does or those actions in existence(Edward-Groves, 2018). The *doings* occur in a physical space with systems of real situations through assigned activities and written work. These activities are classwork, homework or hands-on practical exercises in mathematics. Hands-on activities imply that learners should be offered readily available resources to assist them in being connected meaningfully to the relevant information of mathematics concepts (Asheela et al., 2021; Shinana et al., 2021). Thearrangements looked at the classroom arrangement and what resources were needed to conducta lesson.

In the case of this study, the physical space was the classroom. The way learners were placed in the classroom, the arrangement of desks and the general environment informed the *doings*. If the classes were overcrowded, the *doings* would be constrained. But in the context of this study, the number of learners in the classroom was reasonable due to the COVID-19 pandemicresulting in *doings* being enabled. For instance, the *doings* were enabled when the learners had sufficient space to work and when the teacher offered the opportunity to learners to manipulatedifferent objects such as reading word sums, writing and engaging in practical activities in theclassroom. If the space is not enough or the spatial arrangement is not well organised, learningactivities might be constrained. Then, it could be argued that the material-economic arrangements that condition an action include both human and non-human factors such as resources (Gherardi, 2009; Schatzki, 2012).

2.6.3 Socio-political arrangements

In social space, the *relatings* of our practices are intertwined with social-political arrangements(in the medium of power and solidarity) that enable and constrain how we can relate to othersand the world. Socio-political arrangements are conditions understood in practice through control and agreement as to the *relatings* of teachers (Kemmis & Grootenboer, 2008). *Relatings* occur in a societal space where there is a relationship between the teacher and the learner and the learner and the activity done during a lesson. In this regard, Kemmis and Grootenboer (2008) state that the

teacher is positioned in the network of relationships in the socio-political arrangements practice. The networks in which the teacher is placed are teaching skills,strategies, curriculum and learners' involvement in the classroom (Wang et al., 1993). This means that the roles of both the teacher and learner, power structures or school rules related toissues of power and cohesion that enable and/or constrain the *relatings* take place in the practice. For instance, the relationship between a teacher and a learner is not only shaped by social-political arrangements but also by the layout of a classroom, the number of learners in the school and how people are positioned in the classroom (Sjølie & Østern, 2021).

As explained earlier, this study used ToPA as an analytical tool which enabled me to go deeperinto what constitutes teaching practice concerning the Tomlinson model of DI as it happens in mathematics lessons. Further, ToPA assisted me in zooming in when teachers were implementing DI in teaching mathematics. For these reasons, ToPA was deemed appropriate for this study because it was used as a lens to explore how teachers implemented DI in a Grade3 Mathematics class, intending to gain a deeper understanding of their practices. The ToPA also allowed me to examine how these arrangements influenced teaching and learning practices.

Table 2.2 shows how ToPA assisted me in analysing these teachers' practices. The backgroundfor analysing the connections between practices and the practice architectures (cultural-discursive, material-economic and social-political arrangements) that make them possible in aparticular site is presented. In the table are questions proposed by Kemmis et al. (2014, pp. 81-82) and these assisted me as a guide during the data analysis process.

Table 2.2: The ToPA framework for practice analysis (adapted from Kemmis et al., 2014, pp. 81-82)

Elements of practices	**Practice architectures in the site**
What are the participants doing? – including myself and others – say they are doing, or intend to do or have done? (Note: different participants and others may answer this question differently)	Practice landscape – How do different participants (and others involved or affected) inhabit the site in different ways, that is, interact with different people and objects, and occupy different places and spaces?
Sayings **(communication in semantic space)**	**Cultural-discursive arrangements (Note: one person's *sayings* are also practice architectures that enable or constrain others' *sayings*)**
What do different participants say in the practice as they do it (what language is used, the exceptionally specialised language used in this practice)? What ideas are most important to different participants? What language and ideas do various participants use about the practice (especially to describe, explain and justify the practice before and after they do it)? How are different participants' language and ideas changing?	Where does this language or particular discourse come from (e.g. texts, policies, professional communities, language communities)? Who speaks this language on the site? Who speaks it most/least fluently? Is there contestation among people involved or affected about the language, key ideas or importance?
Doings **(activities, often producing or achieving something, in physical space-time)**	***Doings*** **(activities, often producing or achieving something, in physical space-time)**
What are participants doing? Are theresequences or connections between activities? Are ends or outcomes being achieved?	Material-economic arrangements (Note: one person's *doings* may enable or constrain others' *doings*). What are physical spaces being occupied (over time)? Are particular kinds of set-ups of objects involved? What material and financial resources are applied? (Are the resources adequate?)

Relatings **(relationships in social space, especially relationships of power and solidarity**)	**Social-political arrangements What social and administrative systems of roles, responsibilities, functions, obligations and reporting relationships enable and constrain relationships on the site?**
How do participants (and others involved or affected) relate to one another? Are there systems of positions, roles or functions? Are relationships of power involved? Who is included and excluded from what? Are there relationships of solidarity and belonging (shared purposes)?	Social-political arrangements What social and administrative systems of roles, responsibilities, functions, obligations and reporting relationships enable and constrain relationships on the site? Do people collaborate or compete for resources (or regard)? Is there resistance, conflict or contestation? Is the communicative space a public sphere?
Dispositions (habitus; the interactive capabilities of different participants) Understandings:	**Practice traditions – What do our observations tell us about practice traditions in the site, in the sense of the way we do things around here?**
How do participants understand what is happening? Skills: What skills and capacities are participants using? Values: What are participants' values, commitments and norms relevant to the practice (concerning the people and things involved)?	Is there evidence of professional practice traditions (not exclusive to this site) – like following an inquiry approach in mathematics teaching or following a state policy – and do these enable or constrain what participants hope to achieve on this site?

Kemmis et al. (2014) contend that each of the questions above leads to the information about what is happening in practice, in the view of all participants. The questions further assert that the evidence affords the basis of individual and collective reflection about what to do in the site in light of growing understanding, proposing discussion of new *doings, sayings* and *relatings* and means of engaging the practice architectures to make them more favourable to rational socially just practices.

2.7 Chapter Summary

This chapter reviewed the literature on the theoretical ToPA and conceptual framework, DI. This chapter introduced the ToPA and location within the theoretical terrain of practice theory. Highlights of what is distinctive about the theory as a practice theory were argued. Additionally, this chapter explained the systematic way of understanding and representing theconditions and circumstances in which the social, physical and political world exists through the lens of ToPA.

Also, this chapter defined DI clearly and discussed the different levels of DI. These included the elements of DI and how other researchers view the philosophy for teaching. Further, in thechapter, there was a discussion on how the elements assist in meeting the needs of diverse learners. Moreover, views of learning styles and preferences were discussed as the basis for differentiation. In conclusion, the chapter highlighted the advantages and disadvantages of DI.

CHAPTER THREE: RESEARCH METHODOLOGY

3.1 Introduction

In this chapter, I present the research methodology used in this study. I present the research paradigm and the research design used. The case study approach, the research goal, research questions, site, participants, positionality and reflexivity and sampling are discussed. Further, the chapter discusses the explanatory and qualitative research viewpoints used in this study. Itfurther shows why the case study method was chosen to investigate how teachers implement DI in a Grade 3 Mathematics class.

3.2 Research Paradigm

A research paradigm is how a researcher perceives worldviews (Creswell, 2016). Gephart (1999) claims that a research paradigm is classified into three philosophically selected categories as positivism, interpretivism and postmodernism. According to Thompson (2015), positivists perceive society as moulding the individual. Thompson (2015) further notes that positivists also believe that social issues shape individuals' actions. It looks at a single objectiveregardless of a researcher's belief (Carson et al., 2001). Therefore, the approach of the research becomes quantitative. The positivist paradigm sustains the idea that reality is out there to be studied and understood (Burns, 2000). In contrast, the essential attempt of the interpretive paradigm is to get to know the subjective world of social experience (Guba & Lincoln, 2005). Myers (2008) argues that interpretivism mixes human interest into a study. Forghani et al. (2015) say that postmodernism is a movement that focuses on the reality of the individual and rejects statements that claim to be true for all people. Postmodernism focuses on the individual's existence, noting that the accounts or reports are not true for all people. Thus, it emphasises pluralism (Forghani et al., 2015).

This research is qualitative and located within an interpretivist paradigm, which Gephart (1999) describes as a paradigm that enables the researcher to focus on meaning and understanding the social relations between humans. In this study, my interest was to understand how teachers

perceive and implement DI in their classrooms. The interpretivist paradigm enabled me to understand the meanings attached to this phenomenon by the participants. Accordingly, Cohen et al. (2018) note that the interpretivist paradigm enables the researcher to see the world throughthe eyes of the participant. Thus, the interpretivist researchers should begin with understandingthe individual participants and set out to know their subjective interpretation of the world around them. In support, Bertram and Christiansen (2020) also argue that an interpretivist paradigm seeks to define and understand how people make sense of their world and make meaning of what they do. Qualitative research can be seen as the means to observe how human behaviour can be explained, in particular, within the framework of the social structures (Austin& Sutton, 2014). Hammarberg et al. (2016) add that qualitative methods respond to questions about the participants' actual involvement and point of view. For this reason, I chose the case study research design for my study.

3.3 Research Design

In this study, I used a case study research design. According to Creswell and Clark (2017), a research design includes collecting, analysing, interpreting and reporting data. Thus, a research design influences the methods applied in collecting and analysing it and how the results will be presented. Lastly, a case study explores episodic events in a definable framework, develops comprehensive analyses of single or multiple cases and generally explains 'how'. In this study,I used case study research design.

3.3.1 Case study research design

I chose to use a case study because I wanted to focus on a multiple-case in a real-life situation. My study sought to explore how teachers engage in teaching using DI in their Grade 3 Mathematics classrooms. The qualitative case study assisted me in understanding patterns and connections within carefully observed environments.

Baxter and Jack (2008) suggest that a qualitative case study offers the researcher instruments to study complicated events. Furthermore, a case study enabled me to interpret meaning withinthe social context of the classroom. Harrison et al. (2017) argue that case study designs have been used in numerous areas for academic purposes. The real-life in this context was the Grade 3 classroom. Yin (2014) further suggests that a case study design should be chosen when the focal point of the study is to answer 'how' and 'why' questions. My research sought to understand Grade 3 teachers' understanding of implementing DI in teaching mathematics, and therefore, it

aligned with Yin's suggestions. According to Yin (2018), a multiple-case study involves two or more cases or replications across the cases to investigate the same phenomena with different participants. Yin (2018) further notes that when a researcher focuses on one topic and observes different participants' behaviour, selecting a multiple-case study is best. This was directed by my research intentions as I intended to focus on a single case study where I observed how teachers implemented DI in a real-life situations. Thus, this was an explanatory case study.

The explanatory case study explores the cause-effect of relationships and how events happen (Yin, 2014). According to Dudovskiy (2018), *explanatory case study research* is not used to give a conclusion but aims to explore the research questions. Zainal (2007) postulates that explanatory case studies explore the data closely at surface and profound levels to explain thetrends in the data. Moreover, it helped me to be able to explain why the phenomenon was occurring. In this case, the phenomenon was the implementation of DI and teachers' perceptions thereof. However, case studies have advantages and disadvantages.

To Creswell (2016), case study research is complicated because it is time-consuming. The case study requires sufficient time to collect data and write the report (Marrelli, 2007). For me, thiswas the case when I was doing my research. I spent a lot of time on the study which was partly exacerbated by the COVID-19 pandemic. The case study method involves a detailed and complete investigation of the researched topic. In this situation, 'case' refers to the phenomenon of DI, as represented by four teachers.

The case study method is frequently assumed to be inaccurate (Yin, 2014). The assumption isthat the case study is based on observations and perceptions of one person. There are chances that the presenter of the case may present it inaccurately because they might have missed someaspects completely (Zikmund, 2019). The explanations that are formed in a case study help todescribe data in real-life environments (Zainal, 2007). The case study can be done in a real situation as a benefit (Flyvbjerg, 2006). In the present research, it was hoped that a case studywould enable me to explore teachers' implementation of DI and observe their practices, which might contain unconscious adaptations to meet the needs of learners' different abilities.

3.3.2 Goal of the research

The overarching goal of this study was to examine teachers' understandings and pedagogical insights on teaching mathematics using DI in Grade 3 mathematics classes in different schools in Makhanda.To achieve this goal, the following objectives and research questions were addressed**.**

3.3.3 Research objectives

The objectives of the study were to explore:

1. Foundation Phase teachers implementation of differentiated instruction when teaching mathematics to their Grade 3 learners.
2. Differentiated instruction made visible through the lens of the Theory of Practice Architectures.
3. Strategies that Foundation Phase teachers use in implementing differentiated instruction in their mathematics classrooms.

3.3.4 Research questions

1. How do Foundation Phase teachers implement differentiated instruction when teaching mathematics to their Grade 3 learners?
2. How are the differentiated instruction teaching practices made visible through the lens of the Theory of Practice Architectures?
3. What strategies do Foundation Phase teachers use when implementing differentiated instruction in their mathematics classrooms?

3.3.5 Research site

This study was located within the Eastern Cape region and conducted with FP teachers. The research involved four Grade 3 FP teachers from four different schools in Makhanda in the Eastern Cape. Initially, the study commenced with seven schools that offer Grade 3. The sevenschools received the questionnaires to respond to. I subsequently worked with four teachers who voluntarily agreed to work with me from the seven schools. Schools in South Africa are meant to ensure that all learners receive access to free and inclusive basic education (DoE, 1996). The schools that I worked with were disadvantaged and under-resourced because of thehistorical background of South African schools' inequality.

Thus, in 1994, the National Norms and Standards for School Funding policy was an intervention based on addressing inequalities in schools (Mestry & Ndlovu, 2014). Schools areranked using a quintile system. This system ranks schools according to the poverty guide of the community. Schools that are ranked quintiles 1, 2 or 3, receive considerable subsidies per learner for educational resources and those that are ranked quintiles 4 or 5 receive far less funding from the state. The schools that I worked with fell into quintile 3. These were primaryschools that offered Grades R–7. In the FP, the HL and language of learning and teaching (LoLT) is isiXhosa. Socioeconomic status refers to the level of a person or group on the socioeconomic scale. The level considers social and economic factors such as income, amountand type of education, kind of status and employment, where one stays and religious background (Mattsson & Reed-Bouley, 2017).

The schools I worked with were positioned in Makhanda Township, a socio-economically disadvantaged area. There is a notably high rate of unemployment in Makhanda. As a result, many learners come from homes with no breadwinner. They depend on government grants andsome live with their grandparents. The number of learners in the classrooms was halved as I have mentioned before due to COVID-19. For this case study, I endeavoured to ensure the schools' anonymity. Therefore, I asked the teachers to choose pseudonyms for themselves andtheir schools. The reason for using pseudonyms was to conceal their true identities. Below in Figure 3.1, the Eastern Cape map is divided into two metropolitan municipalities (Buffalo CityMetropolitan Municipality and Nelson Mandela Bay Metropolitan Municipality) and six district municipalities. Illustrated in Figure 3.2 is the Eastern Cape Bridge Union Overview.

Figure 3.1: Regions of the Eastern Cape (https://municipalities.co.za/provinces/view/1/eastern-cape)

Figure 3.2: Eastern Cape (https://www.bridgewebs.com/ecpairs)

3.3.6 Participants and sampling

The objective of qualitative research tries to gain an understanding of an issue through the existing experiences of participants (Bourke, 2014). The process of choosing a representative group is called sampling (Asiamah et al., 2017; Sharma, 2017). And so, a sample is the groupof individuals who take part in the research. Therefore, the individuals who take part are denoted to as participants or informants. In this study, I developed a rapport with participants which made it easy to relate with them.

According to my initial plan, I wanted to give questionnaires to seven schools offering Grade 3 to complete. After that, I would choose four teachers based on their understanding of DI or the responses that showed more robust knowledge of current DI teaching practices. I could notfollow my initial plan because many teachers were not keen on working on the research becauseof the COVID-19 pandemic. Therefore, my selection of four schools did not strictly adhere tothe planned criteria. Nonetheless, it was great to have the four teachers voluntarily agree to work with me. That allowed me to see how different teachers implemented DI as each school had its own school culture. I was allowed easy access to observe lessons for an hour each in various FP classrooms.

Table 3.1: The profile of teachers involved in this study

Teacher	Gender	Age Range	Highest Qualifications	Teaching Experience	Teaching Experience in Grade 3	Teaching Post	School Quintiles
TA	Male	25–35	BEd FP	4 years	2 years	HOD	3
TB	Female	35–50	BEd FP	11 Years	2 Years	Post level 1	3
TC	Female	30–40	BEd FP	14 Years	5 Years	Dep Principal	3
TD	Female	30–40	BEd FP	10 Years	2 Years	Post level 1	3

Teacher A was a male teacher, while teachers B, C and D were females. The Grade 3 teaching experience of these teachers was as follows: Teacher A had three years and was an HOD; teacher B had two years; teacher C had five years and was a Deputy Principal; and teacher D had two years.

3.3.7 Sampling

These sites were conveniently chosen because of their proximity to me and so it was easy for me to reach them. Therefore, I used convenient and purposive sampling and considered a purposive sample of proportionately chosen participants for this research project. During the time of the study, schools had half the number of learners in the classes. That is, learners werealternating their attendance due to COVID-19. Lopez and Whitehead (2013) state that purposive sampling is done

when participants are chosen according to selected criteria associated with a research question. Purposive sampling is also appropriate to be used in the interpretive paradigm by researchers that use a case study approach (Bertram & Christiansen, 2015). Purposive sampling enabled me to choose participants (Tongco, 2007) consciously. For instance, the teachers were purposefully selected from four disadvantaged and under-resourcedschools in this study.

3.4 Research Process

In this study, I consciously planned to gather data in two phases. It was imagined that that would provide detailed descriptions for data collected within a qualitative, interpretivist paradigm. I first observed all four Grade 3 classes. I managed to visit each teachertwice. I observed how the teacher interacted with learners and used teaching materials on the first visit.

Additionally, I noted how the teacher responded to learners during the lesson. Did they appear calm and in control of the classroom? Were they keeping the momentum of the lesson going?How were they achieving that? In this way I became familiar with their classroom practices. During the second visit, I observed teachers' different aspects of teaching using DI. Observations were audiotaped with the permission of the participants. I did not use video sincemy participants were not comfortable with it.

The interviews of the four teachers followed observations. I did a one-on-one interview with three teachers. One teacher opted for a Zoom session for interviews because she was not feelingwell. That is, the teacher showed respect for the COVID-19 protocols. During the interview sessions, I noted that participants were enthusiastic about sharing their teaching experiences. When they shared challenges that their learners experienced during the lesson, I could see thefrustration on their faces when conducting interviews.

3.5 Data collection

Data collection is a vital aspect of any research. In this study, I used two data collection techniques to answer the research questions. In qualitative research using more than one data collection technique is called triangulation (Burns & Grove, 2001). To ensure the validity andtrustworthiness of the data, I collected data in different ways. To understand the real-life situations in the classroom, I used observations as the source of data as reiterated by Cohen et al. (2018). In addition, to further probe the participants' understanding of DI, I used semi- structured interviews. During data collection, especially during the observations, I was mindfulof the teachers' *doings,*

sayings and *relatings* in accordance with the ToPA, and how they usedthe teaching space for teaching and learning practices.

3.5.1 Classroom observations

Observation is one of the tools for gathering data in qualitative research (Creswell, 2014). Observation is a qualitative investigation method where researchers observe participants (Sotoet al., 2019). These researchers suggest three types of observational research: controlled observations, naturalistic observations and participant observations (Soto et al., 2019). Of the three kinds, I used naturalistic observation for my study. This type of observation assisted me to be able to observe behaviours in their natural context which allowed me to study the actionsof the participants while they implemented DI in their classrooms. In this case, I was a participant observer, in that I sat quietly in a corner, listening and taking notes and did not workwith the children or speak with them after our initial greeting.

My observations were continuous in that I was at each school for four days. Each day I observeda mathematics lesson. Each lesson took 55 minutes guided by the CAPS. The teachers grantedme permission to audio record the observed lessons. However, all of them were not keen on being videotaped. These recordings were transcribed and used as the basis of the research data. My observation period differed in the four schools based on the teachers' availability. The observations were based on the definition of practice as a process of socially established cooperative activity involving features of understanding (*sayings*), means of action (*doings*), ways in which people relate to one another and the world (*relatings*) that hang together in a unique project (Rönnerman & Kemmis, 2016). The *sayings*, *doings* and *relatings* wereobserved through the theory where the practice is enabled and/or constrained by cultural- discursive, material-economic and social-political arrangements. Together, these arrangements form the practice architectures that make possible or hold in place practices, in the case of thisstudy, the teaching of mathematics (Kemmis & Grootenboer, 2008). The theory of practice architectures was thus useful for exploring the site-based local conditions that influenced whatwas happening when teachers were teaching mathematics.

I observed how the cultural-discursive unfolded in terms of the kind of language that the teachers used, the choice of words and the type of body language that emerged. Regarding material-economic arrangements, I observed how the teachers optimised the classroom, how learners were organised and the use of resources. I watched how the teachers related to learnerswith the materials

used for teaching under material-economic arrangements; for example, howwas the power factor embraced? The observations were the second level of data collection. DeWalt and DeWalt (2002) recommend that the researcher should be able to understand the phenomena holistically under study (see Appendix H). The questions in the observation guideline were as suggested by Kemmis et al. (2014, pp. 81-82) and served as a guide throughout the data analysis on the third level.

3.5.2 Semi-structured interviews

According to Kallio et al. (2016), the most common data collection methods in qualitative research also include semi-structured interviews. Semi-structured interviews are used extensively in qualitative research to understand the reasons, perceptions, experiences and attitudes of the participants. The interview is described as an interchange of views between twopersons talking about a topic of common interest (Ruslin et al., 2022). The interview schedulewas developed according to the research goal and through the lens of the ToPA. The questionswere planned to create a guide for the semi-structured interviews. These questions assisted meto get answers to research questions 2 and 3.

I conducted semi-structured interviews with four Grade 3 teachers. Semi-structured interviews were undertaken in a flexible way. I planned to have each discussion on different days and foran hour. Even though I had planned for an hour, for some participants I went beyond an hour.The open-ended nature of the questions offered me an opportunity for both the interviewees and me to discuss some topics. The semi-structured interviews used a set of guiding questions(see Appendix I). The interview questions assisted me in getting the narrative behind a participants' experiences and practices, where I looked at three intertwined arrangements in thetheory of practice: the cultural-discursive, material-economic and social-political.

This assisted me in exploring how these teachers understand the concept of DI by how they explained it in terms of cultural-discursive arrangements where it occurs through the use of language; in terms of material-economic arrangements where it appears in the form of doing; and in terms of social-political arrangement through understanding learners and relations. An advantage of semi-structured interviews is that they allowed me to probe further beyond the initially drafted questions (Gill et al., 2008). Moreover, conducting face-to-face interviews allowed me to study the participants' body language, and I made reliable judgments about whether further probing was necessary. Body language is the unexpressed part of communication used to uncover true feelings (Kuhnke-Bernacka, 2015). For instance, the following body language was

evident during interviews: using hands to explain an idea showing confidence in the content; leaning forward to emphasise a point; different facial expressions; and voice tone. With these interviews, I got to find out and understand the thoughtsand actions of the participants regarding DI practices (Honing & Reips, 2008).

As the country was experiencing the COVID-19 pandemic, I acknowledged COVID-19protocols during the interviews. The interviews with all the participants were held at a venue where social distancing was observed and the noise level was under control. I was also mindfulof the fact that face-to-face interviews might not be possible. This was the case with one of theparticipants as TD got sick as we were about to meet. I had already informed my participants that an online interview would take place should that happen and the interview with TD was conducted via Zoom.

Before the interviews commenced, I asked all participants for permission to have the interviews recorded. The recordings assisted me in capturing as much information as I could. I also mademy participants aware that the recordings would be kept safe and were only for personal use. I developed a set of example interview questions (see Appendix I). As much as I had prepared some questions for the interviews, follow-up questions and further clarifications became part of the session.

3.6 Data Analysis

In this study, I methodically employed deductive and inductive approaches to analyse the data. Azungah (2018) asserts that the deductive and inductive approaches provide a widespread form when analysing qualitative data.

Deductive qualitative research takes its point of departure from the theoretical suggestions thatare derived from an exploration of the literature and applies these to the collection and analysisof data (Azungah, 2018). This is why I used the ToPA to look at the data from the observations.On the other hand, in an inductive approach to research, a researcher collects data and then looks for patterns in the data, working to develop a theory that could explain those patterns (Azungah, 2018). When analysing the semi-structured interviews, the data sets were presentedthrough themes where I looked at the patterns that emerged from the themes. Qualitative data analysis involves the logical search for patterns to create full descriptions of the phenomenon under investigation (Gale et al., 2013).

When looking at the observation data, this first level of analysis was by noting what Kemmis (2009) refers to as *arrangements: cultural-discursive*, *material-economic* and *social-political*.In the observation data, I looked at the implications of DI teaching practices for Grade 3 Mathematics teaching. Regarding the cultural-discursive arrangement, I noted the medium of language, i.e. how were the *sayings* of the practices made possible? In the physical space-timeand material-economic arrangements, how were the *doings* of practices made possible? How were *relatings* made possible through the mediums of power, solidarity, agency and social- political arrangements? For this level of analysis a deductive approach was needed and used.

According to Pérez-Paredes (2019), data analysis aims to extract useful information from datato understand research. This was done through the lens of the ToPA. I pulled information relating to practices involving teachers' *doings, sayings* and *relatings* and the three intertwined social arrangements in the ToPA, namely the cultural-discursive, material-economic andsocial-political arrangements. Cultural-discursive arrangements can be achieved through language use that makes the *sayings* of the practice possible, that is, what kind of words are used in lessons (Rönnerman et al., 2017). Material-economic arrangements which are understood in practice as the form of *doings* that the teacher does or those actions that are in existence at that moment (Edward-Groves, 2018). Social-political arrangements areunderstood in practice through control and agreement as to the *relatings* of teachers (Kemmis & Grootenboer, 2008).

The second level of analysis was linked to the interviews with teachers. Here, I used a deductive-inductive approach as I unpacked and examined teachers' *doings, sayings* and *relatings* as they referred to and practiced DI teaching strategies. At this point, I was looking at how teachers used language, how teachers related with learners and the material as well as how they presented themselves to the class during the teaching sessions. I noted how languageand dialogue were used in the *sayings* of words and concepts during the lesson. Here the language constraint emerged very strongly. I listened as they explained the means of actions and interactions and the types of activities that they said they were implementing. This relatedto *doings,* which includes how people relate to one another and the environment during the lesson.

From the emerging data, I put the data into themes. This was guided by Braun and Clark's (2006) six stages of thematic analysis. Stage 1: Familiarise yourself with the data – I familiarised myself with the data by reading and re-reading it. Stage 2: Generating initial codes – I generated initial codes after familiarisation. Stage 3: Searching for themes – this step involved checking the coded

and collated data information to look for potential themes of broader meaning (Braun & Clarke, 2006). Stage 4: Reviewing themes – I looked at coded dataand placed them within each theme to ensure an appropriate fit. I also reviewed relevant codesand data information and put them under each theme. Stage 5: Defining and naming themes –I refined the thematic map and also created a definition of the data and developed the story to describe each theme. During this stage, I produced the report/document. During this final step,I wrote up the results or findings which emerged from the data to address each theme (Braun & Clarke, 2006).

3.7 Validity and Trustworthiness

Golafshani (2003) notes that validity illustrates whether the research assesses what it was supposed to evaluate or how "truthful" the research results are. For my data collection, I used triangulation which assisted me in examining the validity of my research (Golafshani, 2003). Using triangulation entails collecting and analysing data from more than one source. This is one way of ensuring the validity and trustworthiness of qualitative research. Thus, triangulationis a technique used to enhance the credibility and validity of research findings (Burns & Grove,2001).

According to Leung (2015), validity in qualitative research can also be checked by a method known as respondent validation. This method includes testing initial results with participants to see if they still ring "true". This also applies to my case. To ensure the validity of my study and the trustworthiness of this qualitative research, I gave the transcripts from interviews and from my data analysis to the participants for verification. Participants agreed with what I had written on the transcript. Trustworthiness is defined as the credibility of the researcher's findings (Anney, 2014). Furthermore, it is explained that the trustworthiness of a study refers to the level of confidence in the data and explanations and procedures followed to ensure the quality of a study (Polit & Beck, 2014). Through this member checking, participants respondedpositively. They agreed with me about the correctness of the meaning of their experiences during the interviews.

On the 16th June 2022, I had an opportunity to present part of my research on South African Association for Research and Mathematics, Science and Technology Education (SAARMSTE)EC Chapter colloquium. On the 18th January 2023, I presented a short paper at the SAARMSTE Conference. Additionally, on the 25th January 2023 I attended a SAARMSTE EC Chapter special event in which two guests from Australia who are specialist with ToPA presented. Presenting at a colloquium and conference afforded me an opportunity to get feedback from experts on my work. I used the presentation time to talk about the results of my study. Moreover, I had the chance

to meet and interact with national and international experts in my field. From the experts, there was a discussion about the strengths and weaknesses of my research.

3.8 Ethical Considerations

Ethical issues in qualitative research go beyond respondent privacy. They include respect for persons, kindness and fairness during the investigation (Marshall & Rossman, 2014). In this study, I considered ethical issues such as respecting people, respecting the right of participants to participate and the right to privacy. This means that I showed respect to participants as individuals and recognised their rights. The importance of allowing participants to decide whether to participate in the research was adhered to.

I ensured that schools, teachers and learners were kept anonymous. I also maintained that the focus of the research was not on the learners but on observing teachers. Moreover, I argued that the aim and direction of this study were not meant to undermine schools, teachers and their relationships with learners. Lastly, pseudonyms were used throughout the discussions concerning the schools and the teachers.

3.9 Chapter Summary

This chapter discussed the methodology used in this study. Within the method, I discussed the research paradigm underpinning this study and the research design used. An explanation was given of qualitative research as a data collection and analysis method. This chapter defined how the research was conducted, demonstrating the participants' processes. For field research, a qualitative approach was chosen in which individual interviewees were involved in the research procedure. The method used to collect data and the style used in analysing the data were explained. This study explored how teachers implement DI in teaching Mathematics in the FP with Grade 3 learners.

CHAPTER FOUR: PRESENTATION OF DATA FROM OBSERVATIONS

4.1 Introduction

In this study, a structured observation schedule was employed (see Appendix H). In addition to a structured observation schedule, I asked for permission to audio record the activities in the classroom for me to get in-depth information. Teachers allowed me to audio record their practices as they were teaching. As I was observing, I also made detailed narratives that assistedme in gaining more insight into the four teachers' practices in their classrooms. The notes thatI created also enabled me to write a detailed description of teaching instruction related to ToPA.

According to Edwards-Groves (2017), ToPA is one of the extensive collections of practice theories. These practices bring attention to the interest in people's social life and how people, objects, relationships and the surroundings are entangled in the practice site (Edwards-Groves, 2017). Practice architectures analysis in this study included looking at the *sayings* interwovenwith cultural-discursive arrangements in the semantic space (the language and ideas), *doings* interwoven with material-economic arrangements in the material physical space-time(activities, space, materials and time) and *relatings* interwoven with social-political arrangements in the social space (Edwards-Groves, 2017).

4.2 Summary of Observations

The data from the observations addressed the following research questions:

1. How do Foundation Phase teachers implement differentiated instruction when teaching mathematics to their Grade 3 learners?
2. How are the differentiated instruction teaching practices made visible through the lens of the Theory of Practice Architectures?

The tables below show that educational practices are socially formed through dialogue in real lessons within real sites. This means a one-on-one conversation or a group conversation duringthe

lesson (de Bruin, 2020). The dialogue can be between the teacher and the learner or amongstlearners themselves. According to Edwards-Groves (2017), practice architectures analysis includes looking at the *sayings* (the language and ideas), *doings* (activities, space, materials and time) and *relatings* (relationships) in the teaching of mathematics by each teacher, and the practice architectures enabling and constraining factors that shaped the observed lessons.

Observations that I did on the four teachers are illustrated below through the lens of ToPA using the table adapted from Kemmis et al. (2014). Table 5.1 below brings together an idea ofthe pattern of practices and practice architectures that shaped the conduct of pedagogical practices found in the classes of TA, TB, TC and TD lesson activities. Essentially, the table represents a comprehensive breakdown of the occurrences in the respective classrooms during my observations.

Table 4.1: The Practice Architectures framework for practice analysis

Elements of practices	**Practice architectures in the site**
What are the participants doing? – The purpose of the lesson with the TA was to teach learners the money concept and ensure learners could count the money. The teacher also allowed learners to use a variety of money notes and coins using mathematics terminology for money concepts.	The school had an average of 18 learners per class. The number of learners was less than the usual number due to the COVID-19 pandemic. The fewer number of learners allowed teachers to be able to reach several learners with challenges in learning. The teacher could move between the classroom because there was enough space for movement. The duration of the lesson was 45 minutes. Adopted the alternating system for learners to come to school. This system allowed learners to have social distancing. The number of learners in the class was enabling. However, teachers found the system to have some disadvantages for learners' learning. The disadvantages were that the school attendance became poor. Learners would forget the work done in the previous week.

***Sayings* (communication in semantic space)** Some terms for money such as "*Amashumi amane erandi, ikhulu elinamshumi asibhozo anesithoba erandi, and amashumi amhlanu anesixhenxe erands*" [Forty rands, one hundred and eighty-nine rands and fifty-seven rands].	**Cultural-discursive arrangements (Note: one person's *sayings* are also practice architectures that enable or constrain others' *sayings*)** The medium of instruction at the school is isiXhosa. The teacher and learners at the school speak isiXhosa as their HL. Learners, however, were finding it challenging to say money terms in isiXhosa. Instead, it was easy and comfortable for learners to say the money terms in English. The teacher, in most cases, was obliged to say the words in English before translating them into isiXhosa. For this reason, isiXhosa for the learner in this lesson was a constraining practice while English was an enabling practice.
***Doings* (activities, often producing or achieving something, in physical space-time)** The teacher then introduced the learners to the history of money. Then he continued by introducing the lesson by showing learners different coins and notes. The teacher explained the values of the coins and notes.	**Material-economic arrangements** A hand sanitising station is set up in front of the class for learners before they enter the classroom. There was a sanitiser on the teacher's table. The lesson was done early in the morning. Learners were sitting in groups. There were resources available in the classroom to facilitate the process of teaching and learning. The resources were also available in the classroom to facilitate the process of teaching and learning. In front of the class, mathematics charts and number names are on the wall. The number of names was up to 100. The teacher used fake paper money and photocopied coins. The teacher's approach in this lesson was question-and-answer and group discussion. All learners were sitting on the chairs. Because the learners were few, the class was manageable. However, the class was a bit chaotic. The teacher also confirmed that his class is noisy when learners work in groups. Each group would explain the strategy that they had used. The teacher has a table at the back of the class next to his table. He calls this a round table. This table is a space for learners that did not get the concept. They choose how to work out the problem at the round table with the teacher's assistance.

Relatings **(relationships in social space, especially relationships of power and solidarity)** The learners in the classroom appeared to be enjoying their class as I could see smiles on the learners' faces. The teacher also created a conducive environment where it was easy for learners to ask questions. He was moving from group to group, trying to assist learners. That gave him an opportunity to be able to see the learners that are challenged in the lesson.	**Social-political arrangements** The teacher was able to handle the class. The teacher allowed learners to discuss the topic. He gave them some time and later would ask them to share what they were discussing. He had the group leader for that particular activity. The group leader would lift their hand when the activity was done. The group leader's gesture of putting up the hand when the group is done is informed by the rules that learners have to follow when carrying out a practical activity. The teacher also knew what role he had to play and his responsibilities as he was guided by the CAPS in planning and presenting the lesson. The teacher made use of the Rainbow books from the DBE.
Elements of practices	**Practice architectures in the site**
What are the participants doing? The lesson's purpose with TB was to teach learners the concept of time. Terminology for time concept. She showed learners the clock and asked them what the different hands stand for?	There were 20 learners. The class was also halved due to the COVID-19 pandemic. The school used the alternating system for learners to come to school. This system allowed learners to have social distancing. The number of learners in the class was enabling. Teachers worked with fewer learners and this allowed teachers to reach many learners
She was revising o'clock. Learners were using both English and isiXhosa. The teacher probed learners to speak isiXhosa.	with challenges in learning. The medium of instruction at the school is isiXhosa. Together with learners at the school, the teacher speaks isiXhosa as their HL terms in isiXhosa. Instead, it was easy and comfortable for learners to say the money terms in English. The teacher, in most cases, was obliged to say the terms in English before translating them into isiXhosa. For this reason, isiXhosa for the learner in this lesson was a constraining practice while English was an enabling practice.

***Sayings* (communication in semantic space)** Some of the time concept terms include "Nkqo entloko yintsmbi yesibhozo, licala emva kwentsimbi yesibhozo, umkhono emva kwentsimbi yesishumi, umkhono phambi kwentsimbi yesibini". ["eight o'clock, half-past eight, quarter past ten, quarter to two."] emerged.	**Cultural-discursive arrangements (Note: one person's *sayings* are also practice architectures that enable or constrain others' *sayings*)** The lesson started with what learners know by doing mental mathematics counting in 5s. The topic that the teacher was doing with learners was the time concept. She showed learners the clock and asked them what the different hands stand for. She was revising o'clock. Learners were using both English and isiXhosa. The teacher probed learners to speak isiXhosa. The teacher had to start with English to name the terms before saying the words in isiXhosa. The teacher also had to use body parts to explain parts of the watch.
***Doings* (activities, often producing or achieving something, in physical space-time)** The teacher then introduced the learners to the concept of time. The lesson continued by introducing the lesson by showing learners an analogue watch.	**Material-economic arrangements** A hand sanitising station is set up near the door. There was a sanitiser at the table. The learners were sitting in pairs but kept their distance at the desk. The class was a bit cluttered with a lot of boxes. The teacher was unable to move around the class. The teacher wished to have different stations, but she could not because the class was small and the learners were sitting in rows. This does not allow stations in the class. Moreover, COVID-19 has changed the systems in the classroom. The wall had some charts. The teacher displayed professional practice when working with learners. Learners were allowed to express themselves. The teacher was following the curriculum. The teacher used the National Education Collaboration Trust (NECT) material to do the work.
***Relatings* (The social-political dimension in the medium of power and solidarity)** *Relatings* are shaped by how the teacher relates to learners and how learners relate to the teacher and each other.	**Social-political arrangements** The social-political arrangements were enabled through how the teacher related with learners. Learners addressed the teacher in a formal way and with respect. They were following lesson rules. The teacher allowed learners to work as individuals. She also allowed them to assist each

	other. She would probe the learners with questions to share their opinions about the lesson.
Dispositions (habitus; the interactive capabilities of different participants) Understandings:	**Practice traditions (What do our observations tell us about practice traditions in the site, in the sense of the way we do things around here?)**
Elements of practices	**Practice architectures in the site**
What are the participants doing? The purpose of the lesson with TC was to teach learners the concept of fractions. Terminology for fraction concept. She showed learners the clock and asked them what the different hands stand for? She was revising o'clock. Learners were using both English and isiXhosa. The teacher probed learners to speak isiXhosa.	There were 30 learners. The class had a lesser number than usual due to the COVID-19 pandemic. The school used the alternating system for learners to come to school. This system allowed learners to have social distancing. The number of learners in the class was enabling. Teachers had fewer learners to work with. This allowed teachers to reach many learners with challenges in learning. The medium of instruction at the school is isiXhosa. Together with learners at the school, the teacher speaks isiXhosa as their HL. Terms in isiXhosa. The issue of language did emerge in this class as well. Learners were more inclined to use English in terms of naming fractions in words. The teacher kept saying the fractions in isiXhosa to encourage learners to say the fractions in English.
***Sayings* (communication in semantic space)** Some fraction terms are "isinye kwisithathu, isinye kwisihlanu, icala, isiqingatha or ihafu, ikota". ["one third, one fifth, half, quarter".]	**Cultural-discursive arrangements (Note: one person's *sayings* are also practice architectures that enable or constrain others' *sayings*)** The medium of instruction at the school is isiXhosa. The teacher together with learners at the school speaks isiXhosa as their HL. Learners did not have a challenge in saying "ikota," "ihafu" because the words are easy to say and are accepted as borrowed English words, yet they were having a challenge in saying other fraction terms in isiXhosa. The teacher allowed the learners to use English and isiXhosa. The teachers started with using English before isiXhosa. The lesson was on fractions – "amaqhezu." The teacher was encouraging learners to speak. Learners were introduced to $\frac{1}{2}$ - ihafu, $\frac{1}{3}$ - isinye kwisithathu, $\frac{1}{5}$ isinye kwisihlanu. The teacher brought in the blocks for the learners to see what the fractions looked like using the wooden blocks and stack-up blocks.

Doings **(activities, often producing or achieving something, in physical space-time)** The teacher then introduced the learners to the concept of time. The lesson continued by introducing the lesson by showing learners an analogue watch.	**Material-economic arrangements** A hand sanitising station is set up near the door. There was a sanitiser at the table. The learners were sitting in groups. Each group had a leader. The class was well organised. The teacher was able to move around in between the desks in class. The arrangement of the classroom was enabling as there were spaces that allowed the movement of the teacher.
	There were charts on the wall, a reading corner and a maths station. The teacher allowed the groups to work together and develop the solution. She also allowed learners to express themselves. The teacher was following the curriculum. This included school regulations, CAPS policy and code of conduct for learners and teachers. CAPS clearly explains exactly what to teach. The teachers displayed professional practice when working with learners. The teacher used the NECT material to do the work.
Relatings **(The social-political dimension in the medium of power and solidarity**) The teacher used different teaching methods in the lesson to allow different learning styles of the learners.	**Social-political arrangements** The teacher allowed learners to work as an individual. She also allowed them to assist each other. As learners were working in a group, the teacher encouraged them. Learners were allowed to use manipulatives. The teacher permitted learners to work at their pace. The voice of the teacher was loud enough so everyone could hear. The teacher was handling her class pleasantly. She allowed a conducive environment for learning. Encourage classroom communication.
Elements of practices	**Practice architectures in the site**
The lesson started with instruction. **TD** dealt with data handling**.** She asked learners to do the counting in 5's. She did mental maths with learners.	Learners in the class were 17. The school was practising ~~p~~latooning system due to COVID 19. The school chose a different system from other schools because the school avoided absenteeism and learners forgot the work done in the previous week. The total number of learners in the classroom when things are normal is 40. The teacher practised an old style of teaching. She was standing in front of learners as she was presenting the topic. The school started from 7h30 to 12h30 for the first group, and the following group started from 12h30 to 16h30.

Sayings* (communication in semantic space)** The LoLT is isiXhosa. The technical language of mathematics constitutes *sayings* in this instant in data handling, which have particular meanings attributed to them in mathematics. **"Qokelela* idata" ["Collecting data"], "*cwangcisa* idata" (Organising data) "*Tolika* idata" ["Interpreting data"] "*ingxelo* yedata" ["Reporting data"], "*Bonisa iziphumo ze* data" ["Representing Data"] and "igrafu" ["graphs"] "itali" ["tally"]	**Cultural-discursive arrangements** The teacher used both isiXhosa and English. Learners were allowed to respond using both languages. The use of two languages enables learners to learn. Unlike the other three topics, language use is complicated for HL isiXhosa and English. The teacher asks learners to count in 5's. Learners counted using English. She made examples about their hands and feet. She asked them to calculate mentally without pen and paper while doing mental maths. Learners would use only fingers as manipulatives. The teacher showed learners different types of graphs then explained the tally. The teacher gave learners the number 25 and asked them to create the tally
***Doings* (activities, often producing or achieving something, in physical space-time)** Looked at the physical set-ups of material objects in the classroom space. Also, looking at how the learners are positioned, seated or arranged in the space influence what is or can be done.	**Material-economic arrangements** The lesson was done in the morning. The reason for the lesson to start in the morning, the teacher wanted to have learners for mathematics early in the morning while they are fresh. The arrangement of classroom arrangement was the cinema style. Everyone was facing the chalkboard. There was one child per desk. The space was well used in accommodating distancing due to COVID-19. There were charts on the wall. The classroom space was well utilised. The learners were positioned facing the chalkboard. The resources were limited.
***Relatings* (relationships in social space, especially relationships of power and solidarity**) *Relatings* are shaped by the ways teachers relate to their learners. Also, the way learners would relate to the teacher and their peers.	**Social-political arrangements** The teacher handled learners well. There was a good relationship between the learners and the teacher and amongst learners. The teacher allowed learners to come up front and explain their understanding and how they came up with the solution.

4.3 Practice Architectures in Response to the COVID-19 Pandemic

In South Africa, President Cyril Ramaphosa declared drastic ways to curb the spread of COVID-19 on 16 March 2020 (Parker et al., 2020). To prepare for learners' return to school, the DBE developed a guideline document to assist with the phased-in approach to returning learners to

school (Hoadley, 2020). The guideline document looked at different models. These models included learners going to school on a rotational basis, learners alternating classes on different days of the week and a platooning system (Parker et al., 2020).

Looking at the size of the classrooms and the number of learners, all classes of the four teachershad to adapt and respond to the new state of emergency to combat COVID-19. Out of the fourschools, three schools adopted one of the models for learners to attend school. TA, TB and TCused an alternating system for learners to come to school. The requirement for the alternating system was to have half of the class come in one day, then the other half of the class had to come the other day.

On the other hand, TD's school adopted a different school attendance form. It used and practised the platooning system. The first group started at 7h30 and the second group started at12h30.

4.4 Practice Architecture in Different Sites Concerning COVID-19 Protocols

At TA's school, a hand sanitising station was set up in front of the class to sanitise before entering the classroom. Also, there was a sanitiser on the teacher's table where the teacher would spray learners' hands from time to time. The mathematics lesson that I observed occurred in the morning. In TB's school, there was two hand sanitising stations. These were set up at the end of each wing in front of a class. For TC and TD, the sanitisers were hung on the walls inside the classrooms. The mathematics lesson also happened in the morning. The concept of sites in ToPA is not centred on context for practice only rather, practices are shapedbased on the content and conditions of a particular moment (Kemmis et al., 2000). This theoryaccentuates that social reality consists of practices that we do daily. Figure 4.1 below is intended to depict the relationships of these practices embedded in each other.

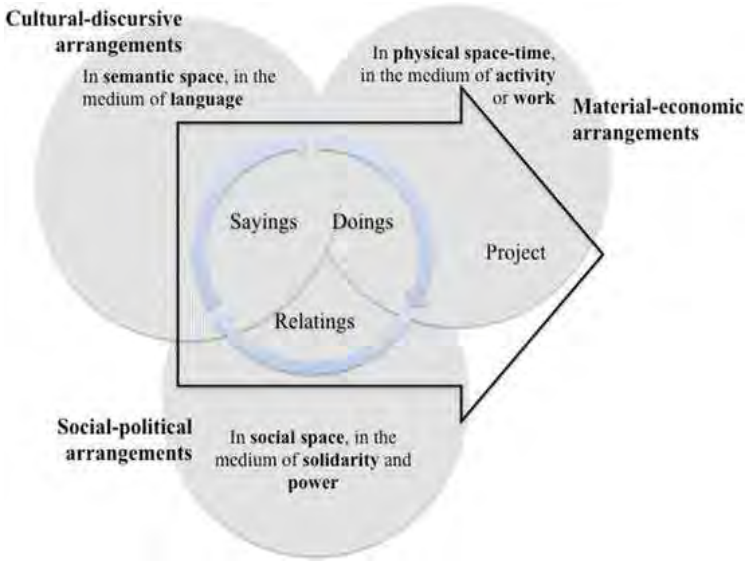

Figure 4.1: ToPA diagram (adapted from Kemmis et al., 2014, p. 34)

4.5 *Sayings* Entangled with Cultural-discursive Arrangements in Semantic Space (the Language and Ideas)

In these spaces where *sayings* are entangled with cultural-discursive arrangements, teachers and learners in classrooms display their actions through their talk. The talk in this study is basedon the LoLT. The LoLT in FP at these schools is isiXhosa which is the HL of both the teachersand learners (DBE, 2010). Therefore, all the observed schools were using isiXhosa as the LoLT.

However, during the observations, I realised that both isiXhosa and English were used duringthe mathematics lessons. In all classes, I noted that as learners were learning mathematics, it was not easy for them to say the number names in isiXhosa. This was astonishing to me. As aresult, teachers first had to say the number name in English before they said it in isiXhosa, eventhough English is not the LoLT. The English language dominated when it came to the namingof numbers. At some stage, the teacher had to probe learners to speak isiXhosa. Hence, that made teachers code-switch from English to isiXhosa to enhance the names being said in isiXhosa as it was difficult for learners to use isiXhosa to say the number names. For isiXhosa-speaking learners, this was sort of a reverse in terms of code-switching. These findings validateSetati (2001), who argues that mathematical learning is constrained in a complicated linguisticspace.

When asking why learners have challenges using isiXhosa in a mathematics lesson, TA highlighted that learners were struggling to name money in isiXhosa. It became even more complicated when they had to say hundreds. For instance, with R325, which in isiXhosa is "*amakhulu amathathu anamshumi amabini anesihlanu*" [three hundred and twenty-five], theyhad to name the number in English first before saying it in isiXhosa. That was not surprising as learners and members of the families use English for money in their homes. For instance, when learners are sent to buy something at the shop, they will be told to buy bread for eleven rands, not for "*ishumi elinanye leerandi*" [eleven rands] as required by the curriculum. This was so revealing that learners had a challenge in using isiXhosa for number names.

When they worked on the concept of money with their teachers, they kept on using English terminology before getting to the isiXhosa vocabulary. An example of an incident was when the teacher asked the learners to do addition and explain how they did the calculation. Learnerswould say "itwenty two-rand *ndayidibanisa ne* three hundred and thirty rand" instead of saying "*amashumi amabini anesibini erandi ndiwadibanisa namamkhulu amathathu anamashumi amathathu erandi*" [twenty-two rands adding to three hundred and thirty rands]. In such circumstances, the teacher had to do some scaffolding (Bruner, 1983). According to Bruner (1983), for the learner to learn complex or abstract content, learning on the part of the learner should be facilitated by the teacher. Therefore, scaffolding refers to different kinds of instructional skills used to transfer learners gradually towards more robust understanding and, ultimately, greater independence in the learning process (Leader, 2014). Moreover, TA tried his best to place himself and the learners in a good situation concerning mathematics language(Setati, 2008).

TB's lesson was on the concept of time. She noted that "*Xa sisuka ku nkqo entloko, imizuzu mihlanu, imizuzu ilishumi de ifike ku quarter past*" [When time moves from o'clock, it goes from five minutes to ten minutes until it reaches quarter past]. "*Abaqhelanga imizuzu ilishumiokanye umkhono emva ngesiXhosa"* [Learners are not familiar with ten minutes or quarter past in isiXhosa], instead, "*Baqhele o five past*, *quarter past*" [Learners are used to five past]. She went on to say: "*Ekhaya abasebenzisi lemikhono namacala"* [At home, they are not using this terminology].

It seems that English influences isiXhosa words or terms as they are long, while in English, the times are shorter and easier to say. Additionally, learners tend to use English terms because they know English numbers before school (Cekiso et al., 2019). Deumert (2006) also discovered that

older siblings in isiXhosa-speaking families with working-class backgrounds tended to speak English with their younger siblings. That encouraged learners to use English more instead of isiXhosa. Similarly, the media also has a strong influence on the language. Forinstance, the isiXhosa radio stations that could assist in giving time in isiXhosa are not consistent with telling time in the language. Dowling (2011), for example, studied the use of English in a broadcast from South Africa's major isiXhosa radio station, *UMhlobo Wenene* FM. Interestingly, as much as the radio station wanted to reduce the number of English loanwords in its programme, they have not succeeded (Dowling, 2011).

TC noted that it is difficult for learners to say fraction names in isiXhosa. They need to express them in English first before they can say them in isiXhosa. For instance, 1/3 in isiXhosa is "*isinye kwisithathu*" and 1/5 is "*isinye kwisihlanu*." However, quarters and a half wereaccessible because these terms were loanwords. As a result, TC had to start by using English before isiXhosa for learners to learn the fraction concepts with understanding. During her lesson, she encouraged her learners to speak.

Learners were introduced to $\frac{1}{2}$ *ihafu*, $\frac{1}{3}$ - *isinye kwisithathu*, $\frac{1}{5}$ *isinye kwisihlanu*.

She brought in some wooden blocks for the learners to see how the fractions looked. She stacked blocks upto show them the different fractions. She then asked the learners to explain them. Learners described fractions as 1/2 *ihafu*. They made an example of bread when it is cut into two halves.However, when it came to 1/3, learners had to name the fraction in English as third. TC repeatedthe fraction as "*isinye kwisthathu*". She also showed the learners fractions in groups.

She then asked the learners to build fractions in their groups and she gave them 30 counters. From 30 counters, she asked them to show 1/3 of 30 counters. As learners were discussing during the lesson, I could hear them say, "*Masohlule ezicounters zibe zigroups ezintathu kuqala*" [Let us divide the counters into three groups first]. "*Emva koko masithathe igroup enyesiyibeke ecaleni yona izakwenza i- one third, ze sizibale ukuba zingaphi*" [After that, we shouldput aside one group, which will make a third, and count how many are they]. Such discussionswere so clear that English used in conjunction with isiXhosa seemed to be an enabling factor enhancing learning.

TD said that her learners were struggling to name numbers in isiXhosa. For instance, when they had to count in fives, they counted in English as follows: five, ten, fifteen, twenty, not in isiXhosa like this "*zintlanu, zilizhumi, zilishumi elinesihlanu ngamashumi amabini*." The reason is that numbers are said in English at home. Hence, for TD to encourage her learners tocount in isiXhosa was a challenge. To minimise the language challenge, she had the number symbols with number names written in isiXhosa on a chart. However, she did not have the counting number words in 2's, 5's and 10's written in isiXhosa. As a result, learners were allowed to respond using English and isiXhosa.

The use of two languages seemed to enable learners to learn. For instance, she asked her learners to count in 5's in English. She then made examples about their hands and feet. She showed them different types of graphs. The word graph was used in isiXhosa as "*igrafu*." *Sayings* in that instance consisted of the technical language of mathematics in data handling, which has particular meanings attributed to them in mathematics. "*Qokelela idata*" [Collect data], "*Cwangcisa idata*" (Organise the data) "*Tolika idata*" [Interpret the data] "*Ingxelo yedata*" [Interpret the data], "*Bonisa iziphumo ze data*" [Represent Data] and "*igrafu*" [graphs]"*itali*" [tally].

4.6 The Relationship between Language and Mathematics within Cultural-Discursive Arrangements in Semantic Space

Language in mathematics learning and teaching is essential in shaping learners' performance (Feza, 2016). The South African education policy proclaims that learners in Grades 1-3 should learn in their HLs (DBE, 2014). Thus, in South Africa, teachers in the FP are required to teach mathematics in the HL. In the case of my research, isiXhosa is the HL (DBE, 2014).

Setati (2008) also brings to light the argument based on the language in mathematics teachingand learning. The extent to which the LoLT policy is implemented within South African schools is difficult to determine due to the strong presence of English. IsiXhosa should be enabling when teaching mathematics. However, in the four classes, I observed that learners' language of preference was English. Therefore, isiXhosa in those classes seemed to be a constraining factor.

In contrast, English seemed to be an enabling factor for learners in mathematics lessons. Teachers, however, strove to encourage their learners to use isiXhosa without discouraging them. It could be deduced then that early literacy has been swayed and complicated by the riseof English as a global language (Setati, 2001). English domination is supported by the demandsof the worldwide economy (Sibanda, 2017) and this could be why parents also encourage theirlearners to speak

English.

4.7 *Doings* Entangled with Material-economic Arrangements

In physical space-time, the *doings* of our practices are entangled with material-economic arrangements (in the medium of activity and work) that enable and/or constrain where we cango and what we can do. The material-economic arrangements are understood in practice as theform of *doings* that the teacher does or those actions in existence (Edward-Groves, 2018). The*doings* occur in a physical space with systems of real situations through the mode of assigned activities and written work. In the case of my study, the *doings* occurred during teaching and learning in the classrooms I observed.

For instance, in TA's classroom, learners were sitting in groups. This was particularly important because the COVID-19 measures included maintaining distance in the classroom. Learners in the classroom were half the actual number of the class. The reduction in numbers created space for learners to be in small manageable groups. For instance, the number of learners in TA's class was 18. That was half the number of his total number of learners in his class. As a result, he was able to move in between the desks. The arrangement of the classroomwas enabling as the space allowed the movement of the teacher.

The resources were also available in the classroom to facilitate the process of teaching and learning. Mathematics charts and number names were available on the wall in front of the class. The number names were up to 100. The teacher used fake paper money and photocopied coinsto make his lesson enjoyable. Such activity was conditioned by the material-economic arrangements that included human and non-human factors such as resources (Kemmis et al., 2013).

TA's approach in his lesson was mostly question-and-answer and group discussions. All learners were sitting on the chairs in groups. Because the learners were few, the class was manageable. However, the class was a bit chaotic. The teacher also confirmed that his class isnoisy when working in groups. Each group would work with different kinds of resources. These were photocopied paper money and coins. He explored financial literacy with his learners. During the activities of the money concept, the practice was done within the physical space (Grootenboer & Edwards-Groves, 2013). In the lesson, I observed that as learners were working, the teacher guided them during the mathematics lesson as learners were showing persistence when they continued with problems that they encountered with the activities (Blueet al., 2018). As the

learners were working in groups, they supported each other to reach the required goal. They also displayed care, empathy, respect and understanding (Grootenboer & Marshman, 2016).

At the back of the class, TA had a table. He called that a round table, a space for learners whodid not understand the concept. At the round table, learners had to choose how they would work out the problem with the teacher's assistance. That space allowed learners to learn at theirown pace and in the best way they could to understand the concept. In that space, the rate wasoften connected to meeting learners at the appropriate level of challenge. This is in line with teaching within their zones of proximal development, or the difference between what a child can do with help and what they can do without assistance (Vygotsky, 1978).

Regarding TB's lesson, it was done early in the morning. TB introduced learners to the conceptof time. The lesson continued by showing learners an analogue watch. The learners were sitting in pairs but kept their distance from the desk. The class was a bit cluttered with a lot of boxes;as a result, TB was unable to move around the class. She wished to have different stations, butshe could not because the class was small and the learners were sitting in rows. Moreover, shecommented that COVID-19 had changed the systems in her classroom. She allowed learners to work as individuals. She also allowed them to assist each other. The wall had some charts, but the space was not enabling.

The purpose of the lesson with TC was to teach learners the concept of fractions. She showed learners the clock and asked them what the different hands stood for. Essentially, she was revising the o'clock time. Learners used both English and isiXhosa. The teacher probed learners to speak isiXhosa. The learners were sitting in groups and each group had a leader. The class was well organised. TC was able to move around in between the desks in class. Thearrangement of the classroom was enabling as there were spaces that allowed the movement ofthe teacher. There were charts on the wall, a reading corner and a mathematics station. The teacher allowed the groups to work together and develop a solution. She also allowed learners to express themselves. The teacher was following the curriculum. That included school regulations, CAPS policy and code of conduct for learners and teachers. The CAPS clearly explains exactly what to teach. TC displayed professional practice when working with learners.The teacher used the NECT material to do the work.

In TD's class, the lesson was done in the morning because the teacher wanted to have learnersfor mathematics early in the morning while they are fresh. The teacher was always in front of the class. The class was not cluttered. There was space for moving around the class but the teacher did not utilise the opportunity. The arrangement of the classroom was the cinema styleand everyone was facing the chalkboard. There was one child per desk. The space was well used to accommodate distancing due to COVID-19. There were charts on the wall. The classroom space was well used. The resources were limited.

4.8 *Relatings* Entangled with the Social-political Arrangement

TA allowed learners to discuss the topic. He gave them time and later would ask them to share what they were discussing. The relationship between the teacher and learners was pleasant. He called the learners who were unclear about the topic to the round table. At the round table, learners were allowed to use the resources the way they understood them. This gesture of calling learners to the round table was an enabling factor. The teacher alleviated the power relationship between him and the learners (Kemmis & Grootenboer, 2008). *Relatings* occur ina societal space where there is a relationship between the teacher and the learner, and the learnerand the activity done during a lesson. Kemmis and Grootenboer (2008) state that the teacher ispositioned in the network of relationships in the socio-political arrangements practice. The learners in the classroom appeared to be enjoying their class as I could see smiles on the learners' faces. TA also created a conducive environment where it was easy for learners to askquestions. He was moving from group to group, trying to assist learners. How the teacher worked with learners enabled the teaching practices entangled with social-politicalarrangements (Kemmis & Grootenboer, 2008).

Relatings are shaped by how the teacher relates to learners and how learners relate to the teacherand each other. With TB, the social-political arrangements were enabled through how the teacher related with learners. Learners addressed the teacher in a formal way and with respect.They were following lesson rules. The teacher allowed learners to work as individuals. She also allowed them to assist each other. She would probe the learners with questions to share their opinions about the lesson.

TC allowed learners to work as individuals. She also allowed them to assist each other. As learners were working in a group, the teacher encouraged them. Learners were allowed to use manipulatives. She permitted learners to work at their own pace. The voice of the teacher was loud enough so everyone could hear, and the teacher handled her class pleasantly. She allowed a

conducive environment for learning to encourage classroom communication. TC seemed to practice an old style of teaching. For instance, she was standing in front of learners as she was presenting the topic.

TD handled learners well. There was a good relationship between the learners and the teacherand amongst learners. She allowed learners to come up upfront and explain their understanding and how they came up with the solution.

4.9 Chapter Summary

This analysis closely examined how ToPA arrangements were linked to mathematics teachingin the Grade 3 classrooms. The link was based on the *doings, sayings* and *relatings*. One of the fundamental purposes of classroom observation in this research was to describe and explain the current status of instructional practices and identify what enables the instructional practices.Above all, using observational methods brings about essential information that will have practical implications for improving teaching practices.

CHAPTER FIVE: PRESENTATION OF DATA FROM SEMI-STRUCTURED INTERVIEWS

5.1 Introduction

Bingham and Witkowsky (2021) describe that inductive analysis is when the researcher reads through the data and lets the codes and themes emerge. This chapter interprets, analyses and discusses data derived from the semi-structured interviews. These data gathering methods responded to my research question three:

> *What strategies do Foundation Phase teachers use when implementing differentiated instruction in their mathematics classrooms?*

I collected the data from four teachers who were participants in my study, and I gave them the following codes: TA for teacher A, TB for teacher B and so on (see Table 3.1). To illustrate the data source in relation to my participants, I used TAI-TDI for the semi-structured interviews.

5.2 Qualitative Data and Findings

Consistent with ethical protocols, the initial step that I took was to ask permission from the four participants to conduct interviews with them. Additionally, the questions asked in the interviews were recorded with the teachers' permission. After the interviews, I immediately transcribed the recordings verbatim so that there was no information distorted or lost. I began the analysis of the data from the interviews in a systematic manner using themes where similar answers had the same colour code.

I read through the responses to get a sense of what the participants said. After that, I mapped out general categories to put each response in a code. The colour coding was done in all three tools I used to collect data. According to Jänicke et al. (2017), colour coding text is a method that is predominantly used during the analysis process. Further, Jänicke et al. (2017) state that colour coding is the same as marking text in a book with a highlighter. From these codes, somethemes emerged (Caulfield, 2019). Such themes subsequently informed my discussions.

Table 5.1: Shows themes and the related literature/theory

Research Question 3: What strategies do Foundation Phase teachers use when implementing differentiated instruction?		
Themes	**Key concepts**	**Theory/ Literature**
Beliefs regarding differentiated instruction	Different learning	Ireh and Ibeneme (2010); Eddinger (2003); Tomlinson (2000; 2001)
Planning for different abilities and learner diversity	Planning Diversity	Chamberlin and Powers (2010); Hillier (2011); Tomlinson (2001)
Offering equal opportunities to accommodate and assist learners	Inclusive Education Different teaching methods Visualisation	Halls (2002); Nelson (2014); Hillier (2011); Chikiwa and Schäfer (2019)
Motivation in using differentiated instruction	Learner's pace All learners learn	Bondie (2019); Tomlinson (2003); Brownell (2001); Russo et al. (2018)
Challenges regarding using Differentiated instruction	Lots of administration Time-consuming Overwhelming	Hertberg-Davis and Brighton (2006); McTighe and Brown (2005)

I now discuss each of these themes below.

5.2.1 Teachers' beliefs regarding differentiated instruction

From the semi-structured interviews, TA acknowledged that learners have different learning abilities. Thus, in his opinion, DI is meant to assist the teacher and learners in the teaching and learning process. For instance, he commented, "*First of all, my belief is that all the learners have different learning abilities".* This statement is in line with Ireh and Ibeneme (2010) that DI is not a method of teaching as such, but instead is a set of beliefs about teaching and learning.Further, Eddinger (2003) adds that DI considers the fact that the socio-cultural backgrounds of learners are different. Therefore, teachers' knowledge and integration of learners' socio- cultural contexts can influence how they teach mathematics (Mavuru & Ramnarain, 2020).

Additionally, from his response to the questionnaire, TA seemed to show an awareness of DI by noting that DI is a philosophy of effective teaching that shows that learners learn differently.In this regard, he commented, "*My opinion in DI is that I believe that DI is meant to assist theteacher*

and the learners in terms of how one teaches and learners learn".

The statement above aligns with Tomlinson (2000), who avers that DI is a philosophy about teaching and learning. That is, differentiation includes how teachers react to all learners' needs (Tzanni, 2018). Tzanni (2018) further reiterates that, in general, this is thought of as providing access points to learners with diverse needs to learn and grow. Shulman (1986) suggests that teachers' beliefs play a crucial role in teaching and learning. That is, teachers' beliefs influence guiding the implementation of DI. Teachers' perceptions and beliefs echo their teaching methods in the classroom, which affect learners' academic development.

Unlike TA, though, TC had a vivid idea about DI. For instance, TC postulated that "*Ndikholwa okokuba abantwana ba interact"* [I believe learners should interact]. Nonetheless, this finding coheres with Vygotsky (1978), who suggests that learning is not something that takes place in isolation but develops within a social setting. On the other hand, TB and TC emphasised the importance of learners talking in class while doing their work. For instance, TC noted that "*Amaxesha amaninzi iclass yam iba chaotic because siyathetha siyenza*" [Most of the time, my class becomes chaotic because we are talking and doing]. From TC's statement, she believes that learners should discover the information by interacting and talking with each other, as Klein (2000) espouses. Therefore, it could be hypothesised that TC favours creating a conducive learning environment for learners, which is critical for DI (Tomlison, 2001).

Additionally, TC noted that *"Mna ndingulatitshala ukholelwa ukuba abantwana mabayikhangele I information, lonto ibenza basebenze ngomdla"* [I am that kind of a teacher that believes that learners should look for information on their own and that helps them to learnwith interest]. These findings cohere with Abdullah et al. (2012), who proffer that such encouraging attributes actively motivate learners to participate in the classroom.

However, in contrast to TB and TC, TD highlighted the importance of using different teaching methods. For instance, she believes in taking learners from the known to the unknown (Kuhlane, 2011). This finding resonates with Tomlinson (2001), who contends that DI is a philosophy on how to teach learners with different abilities. In agreement with this, Phan (2011) argues that it is vital for teachers to elicit learners' prior knowledge of what they learn (Mavhunga & Rollnick, 2013). Elicitation of previous knowledge is imperative in learners' understanding because it allows and helps them to make connections to the new information (Kuhlane, 2011;

Mavhunga & Rollnick, 2013). These scholars believe that eliciting learners' prior knowledge enables them to explore different avenues for achieving their learning goals. Furthermore, this approach agrees with Fernandez and Yoshida (2012), that learners enjoy learning when they are taken from the known to the unknown. In this regard, Johnson (2018) avers that teaching learners with different learning abilities requires creativity, time and a desireto understand how a learner learns best.

5.2.2 Planning for different abilities

TA commented that DI is meant to assist the teacher in considering learners' diverse abilities.She further elaborated, *"Yes, not all learners are the same. DI meets individual needs*" (TAI).This statement seems to agree with Chamberlin and Powers (2010) that there are different waysto differentiate instruction to accommodate different abilities.

In this regard, TB highlighted that "*Planning iyi one but kufuneka ndibahoye bonke. Kufuneka ndiye kubo ndibacacisele ngokwezidingo zabo"* [There is one plan, but I need to cater to every child and go to each child to explain according to his or her needs]. From this excerpt, it couldbe deduced that TB seems to understand the importance of individual learning. Resultantly, she seems to tailor her work according to the needs of her learners. Similarly, TC and TD stipulated that one has to plan different activities for different learners as a teacher. These findings corroborate with Tomlinson (2001), who reiterates that DI involves adapting the quality of teaching to match learner needs.

Moreover, all four teachers also affirmed this articulation in the questionnaire in different ways.For instance, TA noted that "*I understand the different needs of my learners and their abilities".* TB concurred and said, "*The use of DI enables all learners to participate in the lesson".* Moreover, TC noted that *"they use different strategies to meet their learning needs. Therefore, teachers need to develop effective teaching strategies and implement creative solutions to meet every learner's individual needs in the class",* while TD noted that *"DI meets the individual needs and the teacher can manage what learners learn, how learners learn andhow can learners be are assessed".*

They said that in DI, teachers proactively adjust the curriculum, teaching methods, resources, and learning activities to deal with the needs of individual learners in the classroom (Hillier, 2011). Further, TA noted that "*I asked learners to call 50c, R1, not just mention number".* Thatis, TA gave learners play money. TB "*showed learners that the time is quarter past – umkhono emva*

kwentsimbi yesi…". This suggests that TB used the drawing of the watch and the body parts to determine the position of 'past' on the clock. Indeed, this is important since learners in the classroom have different abilities. Hence, this requires the teacher to plan to accommodate learners' different abilities, as reiterated by Skae et al. (2020). TC indicated that she brought in wooden blocks to use so that the learners could see what the fractions look like.

TB emphasised and encouraged learners to say the mathematics concepts. 1/2 – *ihafu*, 1/3 – *isinye kwisithathu*, 1/5 – *isinye kwisihlanu.* In accommodating learners with diverse learning abilities, TB allowed them to count using English since she realised that English seemed to beenabling for learners. Additionally, she made examples of their hands and feet. That is, her learners would use only fingers as manipulatives. In attesting to the teachers' responses in thequestionnaires, the teachers' responses showed the different methods and resources they use when they teach. TA affirmed that "*I am making learners own their learning process*". He further asserted that *"I allow learners to use concrete material, something they can see*". Investigation about learning styles has shown that learners succeed academically in learning environments that meet their learning styles (Wiginton, 2013).

TA reflected that his learners have learnt to be free with him in this regard. Resultantly, that has helped him to plan for his classes and it has always been easy for him to have learners working in groups. On the other hand, TB cited that the seating arrangement in her small classis a hindrance or constraining factor to the effectiveness of DI. In this regard, she commented that "*I would like to have different stations but I can't because learners are sitting in rows, thisdoes not allow stations in my class*. *Moreover, COVID-19 has changed the systems in my classroom"* (TBI).

From this excerpt, it seems that TB acknowledges the importance of space which has even been affected by COVID-19's social distancing protocol. That is, space also plays a large role in teaching mathematics, and it is imperative to have a spacious classroom. In addition, TA expressed that he encourages a space that promotes the expression of new ideas and acceptanceof diversity.

When undertaking learning stations, learners perform different learning activities in the mathematics classroom (Aydogmus & Senturk, 2019). Thus, Moluayonge and Park (2017) posit that the size and management of mathematics classes have a consequence on the teachingpractices of a mathematics teacher. However, TB indicated that she is innovative and changesher classroom

organisation depending on the activity at hand.

All four participants involved in this study agreed that learners in their classrooms are important. For instance, TA noted that he allows learners to make mistakes and then developsthe activities from the errors. Aligned to the above statement, Brodie (2013) claims that to improve practice, a creative style of teaching mathematics includes three strands where the teacher works with the information from their classrooms to understand and engage with learner errors in mathematics. Also, Chauraya and Brodie (2018) aver that discussions about learner errors bring attention to understanding the learner errors, which provide possible reasons for the learners' learning needs.

5.2.3 Offering equal opportunities to accommodate and assist learners

Planning for learners' diverse abilities also provides an inclusive environment. TA and TC highlighted that *"iDI inika abantwana amathuba okufunda izibalo ngokwendlela yabo*" [DI affords learners opportunities to learn mathematics according to their ways]. As TA was describing, he said that when he is teaching the concept of money, he allows learners to learn in their ways. For instance, TA claimed that "*I believe that learners deserve equal opportunitiesbased on their learning ability*". Some learners need concrete materials, while for others, it is easy to understand the concept when they use manipulatives. Tactile learners learn best when they can do "hands-on" activities with materials. Working with materials provides them with the most successful learning situation (Masruddin, 2018).

The same applied to TB. Concurring with the two teachers, TC further affirmed that "*iDI ikwenza okokuba ungashiyi namnye umntana, akuhambi nabahambayo, ikunika ithuba lokubaufikelele kuye wonke umntwana*" [DI helps you not leave learners behind, it allows that the teacher reaches every child].

These utterances resonate with Halls (2002) who states that to differentiate the instruction is to recognise learners' diverse socio-cultural backgrounds (Mavuru & Ramnarain, 2020). Differentiated instruction (DI) allows teachers to teach the same material to all learners using various instructional strategies to accommodate them. For instance, TD explained that:

> *Abantwana bafunda ngokwendlela yabo, omnye umntwana uqonda ngcono xa uthetha kodwa omnye uqonda ngcono xa izipictures ingakumbi kule lesson besiyenza yokudibanisa ndisebenzisa inumberline* [Learners learn in their own ways, for instance,

> one learner understands better while you are talking whereas another learner understands when you are using pictures, especially in the addition lesson that we did].

In terms of DI and as far as TD is concerned, pictures assist in supporting visual learners. A visual learner usually works best alone or maybe with one other person and for reading and reviewing, visual learners learn well by seeing words or numbers in the book. This explanationcollaborates Flevares and Schiff's (2014) assertion that pictures develop learners' positive attitudes and resilience towards mathematics. Further, visualisation as a teaching strategy playsa crucial role in mathematics understanding (Chikiwa & Schäfer, 2019).

TC agreed with TD and reflected that "*Learners learn better when they see objects and do something practical in a mathematics class".* TC further revealed that she uses wooden blocksand colourful objects in her lessons on fractions. TD noted that she uses number lines and counters when teaching addition. She alluded that "*My learners learn better when they see objects and do something practical*". TC said, "*The use of concrete material allows me to reachall of my learners".* The two declarations identify directly with Gardner (2013), who asserts that learning and teaching materials should be presented in various ways.

In summary, from the findings above it emerged that differentiation is a way of teaching that requires teachers to know their learners well enough to offer each learner the knowledge that improves learning (Robb, 2013). Moreover, learners arrive in the classroom with distinctive capabilities and conditions that affect learning (Landrum & McDuffie, 2010). Thus, DI requires teachers to adjust the curriculum to address the needs of individual learners to expand or maximise their learning opportunities in the classroom (Hillier, 2011).

5.2.4 Motivation in using differentiated instruction

It emerged from the findings of this study that knowing and understanding learners is what motivates TA to teach mathematics using DI. For instance, TA mentioned that "*learners are not pushed beyond their limit, but accommodated and improved from their standard"*. TA said:

> *The motivation to use DI stemmed from my childhood experience. When I was growing up, I was unjustly treated as a learner. I was told that I could not progress because I was too slow. When one is labelled as slow in learning, that hinders his/her progress*.

This is portrayed by Taylor (2021), that when learners are labelled by ability, the labelling restricts or limits their ability to learn. The other incident was when he was shown a group of learners on his first day in teaching. He said:

> *I was asked to look at the corner where there were a group of learners. I was told not to worry about those learners as they may repeat because there is not much you can do about them.*

Those two incidents encouraged him to focus on those learners who were usually labelled as slow learners or unable to succeed. The other positive thing about DI is that it allows teachersto observe and understand the differences and similarities between learners and plan accordingly (Robb, 2013).

Notably, TA indicated that he is motivated to use DI because he feels that he was never allowedto be successful when he was a learner himself as a child. In line with TA, Tomlinson (2003) contends that DI classrooms acknowledge individual differences in learners' previous knowledge and abilities in every learning situation. And so it seems that TA has been consciousof the learners that were so-called "slow" learners.

During the interview, TD indicated that, indeed, there are very slow learners that need more attention. "*So I allowed learners to learn how they can understand the concept using different resources"* (TDI). According to Usher (2019), calling learners slow, fast and average is incorrect. Instead, it is about the learner's ability to acquire all academic skills below, moderateor above average. The assertion by TD is confirmed by Bondie (2019) who proffers that whenthe learning needs of the learners cannot be addressed through modified instruction only, teachers should make use of resources that will address them. Further, Halls (2002) points out that to differentiate the instruction is to recognise diverse learners' socio-cultural backgrounds(Mavuru & Ramnarain, 2020).

In this regard, TD said that she is motivated to use DI because it allows learners to learn the way they want. TC noted that when the learner has a barrier, the child becomes discouraged and withdrawn just because they cannot write. Therefore, teachers should plan to accommodatethe different needs of learners. TC was thus motivated to use DI so that she is able to move thelearners from one level to the next. Vygotsky (1978) refers to this as the zone of proximal development.

For her, seeing learners progress is what motivates her.

According to Tomlinson and Edison (2003), a differentiated classroom provides a safe and non-threatening environment that promotes learner learning. TB, TC and TD reckoned that DIhelps them to be able to reach all their learners. Differentiated instruction (DI) enables all learners to find meaning and significance in the lesson content and activities (Santangelo & Tomlinson, 2009). Therefore, for learners to find meaning in the lesson content, the teacher should be creative when developing a lesson for DI implementation (Hall, 2002). In line with this statement, TA said that he allows learners to have the democratic right to ask if they do notunderstand, while TD endorsed that planning the fraction lesson based on play and games makes the class vibrant. TD gives groups fraction games to play so that learners can practice in the classroom. Games induce learning in learners because they like to win. TD further indicated that:

> *Even though there will be a winner in a lesson, I make sure that does not negatively affect learners who did not win. Everyone becomes a winner as long they come up with a solution. It is not about the speed which comes first and so on*.

TD showed that game playing is a powerful instructional tool. The notion of a game in a mathematics class assists in overcoming challenges in learning mathematics (de Freitas, 2018). Mathematical games should be enjoyable and create mathematical talk (Russo et al., 2018). TB reflected that she uses concrete mathematics resources, something that learners can see to support learning. Witzel et al. (2001) suggest that interactive experiences with concretemanipulatives can improve the relevance of mathematical material for learners.

5.2.5 Challenges regarding using differentiated instruction

In their interview responses, TA and TB noted that they have to think about the different learners in the classroom when planning for their lessons. For instance, TB said, "*kufuneka ndiplanele umntwana ngokendlela afunda ngayo*" [I need to plan how the learner learns]. Concurring, TC highlighted that it does take up some time, especially during planning. TD also echoed TC's sentiments and commented that DI is time-consuming because it requires a lot ofplanning and a lot of organisation. These findings are congruent with Hertberg-Davis and Brighton's (2006) findings that DI involves a lot of administration. Therefore, if one plans forlearners, planning should be for all learners where the teacher has to accommodate diverse learners' requirements and strengths (McTighe & Brown, 2005).

Moreover, TD noted that sometimes the challenge is teaching aids. Thus, DI demands that a range of materials and resources be available (Asheela et al., 2021; Shinana et al., 2021) for learners with different learning styles. Chingos and West (2010) assert that learning materialssuch as textbooks are essential in enhancing instruction. In light of these DI challenges, TA acknowledged that there is a need to train teachers to use the different elements of DI. For teachers to practice DI, they need to identify learner diversity. Since learners come from diverse socio-cultural backgrounds (Mavuru & Ramnarain, 2020), they also have different intellectualstrengths. This means that teachers have to differentiate between assisting each learner in learning and improving their learning with strategies to reach their academic needs (McMahon, 2019).

It also appeared that all four teachers tend to struggle in providing all learners access to specific learning activities that work best for them. That could partly be due to insufficient training in using a flexible and differentiated curriculum that can be adapted for learners' diverse needs and barriers to learning (de Jager, 2013).

As alluded to earlier, the data presented in these themes show that these teachers, although possibly unintentionally, did differentiate in some curriculum areas during their class activities.It came across so strongly that there is a need to train teachers on DI. Some teachers received training on IE but have never done training on DI. Hence, teachers seem not to know what theDI elements entail. TA witnessed this by voicing, *"I did not know anything about DI elements.I came to hear about them during interviews"*. In this regard, TA reflected that "*I did receive the training on IE; however, nothing was said about DI. I have learnt something about the elements as you explain them"* (TAI).

TC also agreed with TA and commented: "Elements of DI are not something that I know. When receiving training on IE, we were never informed about DI. Actually, DI was not part of the agenda". TD also noted that "No, I do not know the elements". With such a response, TD clearly showed that there is a need for training so that she could know and understand the elements of DI.

5.3 Chapter Summary

This chapter presented the findings from the semi-structured interviews of the four teachers involved in this study. I moved to the emerging themes from the respondents' answers to their questions. Participants' voices featured significantly in the discussion of the themes. While I was conducting this qualitative research, I made sure that I maintained a non-biased stance during the

analysis. I thus interpreted my results in the light of relevant studies, theories and concepts related to my research.

CHAPTER SIX: SUMMARY OF FINDINGS, RECOMMENDATIONS & CONCLUSION

6.1 Introduction

This chapter will present closing remarks on the main research findings, followed by recommendations that emerged from the analysis of these findings. There will be a discussionon the limitations and strengths of the study. The chapter will end with suggestions for future research and a final reflection on the research process as a whole.

This case study examined how Grade 3 FP teachers implemented DI in their mathematics classrooms. The study also looked at how the DI teaching practices were made visible through the lens of ToPA.The overarching goal of this study was to examine teachers' understandings and pedagogical insights on teaching mathematics using DI in Grade 3 classes in different schools in Makhanda.To achieve this goal, the following objectives and research questions were explored.

The objectives were to explore:

1. Foundation Phase teachers implementation of differentiated instruction when teaching mathematics to their Grade 3 learners.
2. Differentiated instruction was made visible through the lens of the Theory ofPractice Architectures.
3. Strategies that Foundation Phase teachers use when implementing differentiated instruction in their mathematics classrooms.

Research questions:

1. How do Foundation Phase teachers implement differentiated instruction when teaching mathematics to their Grade 3 learners?
2. How are the differentiated instruction teaching practices made visible through the lens

of the Theory of Practice Architectures?

3. What strategies do Foundation Phase teachers use when implementing differentiated instruction in their mathematics classrooms?

6.2 Summary of Findings

The findings of this study are presented in relation to my three research questions.

6.2.1 Research question one

How do Foundation Phase teachers implement differentiated instruction when teaching Mathematics in their Grade 3 learners?

The study's findings revealed that DI modelled by the participating teachers showed they lacked knowledge of some of the elements of DI. This calls for training programmes and workshops on DI. It was clear that teachers did practice DI up to a point. However, as they were doing so, they were not clear in their practices on what part of DI they were implementing during teaching. Moreover, they also seemed not to understand that DI involves diversity in that the lesson should involve diverse activities and were not clear on how best to achieve that.

This lack of DI knowledge was affirmed in that several teachers encountered numerous challenges in DI implementation (Manivannan, 2020). Manivannan (2020) suggests that challenges could vary from external factors such as school management support to factors likeself-efficacy. The importance of training is echoed by Dixon et al. (2014) when noting that teacher training programmes on DI are vital in preparing teachers to implement DI with confidence.

6.2.2 Research question two

How are the differentiated instruction teaching practices made visible through the lens of the Theory of Practice Architectures?

This study revealed that differentiating practice in terms of *doings*, *sayings* and *relatings* was necessary for teachers. The study also revealed that learners in all classes I observed had to say mathematics terms in English before attempting them in isiXhosa. The use of English in the lessons showed that the isiXhosa HL, which was meant to be enabling, became a constraining factor. In contrast, however, English became an enabling factor. This is quite a revelation for isiXhosa speakers in the FP classes.

This study further revealed that DI practices, when executed using diverse activities, resourcesand material set-ups influence the physical space. According to Edwards-Groves and Kemmis (2015), these intersubjective spaces are interactive and exist in language, area-time in the material world, and social relationships. For instance, cultural-discursive arrangements exist inthe dimension of semantic space, enabling and constraining how we can express ourselves in the social medium of language. This was evident when learners expressed themselves in English when they had to mention mathematics terminology in an isiXhosa LoLT class. In thatinstance, isiXhosa was constraining.

Material-economic arrangements exist in the dimension of physical space and time that enableand constrain how we can do things in the medium of work and activity. The use of concrete materials during lessons was enabling. Social-political arrangements that exist in the dimensionof social space seem to enable and constrain how teachers can connect and contest with one another in the social medium of power and solidarity. This was evident when TA and TC allowed learners to work in groups. TA further allowed learners to sit with him at a round tablewhere they discussed the challenges of the activity that they were doing.

6.2.3 Research question three

What strategies do Foundation Phase teachers use when implementing differentiated instruction in their mathematics classrooms?

Teachers showed some understanding of DI concepts (Tomlinson, 2014). For instance, TA invited learners to the round table; at the round table, learners were allowed to do the activity according to their understanding. As part of DI implementation, learners can be allowed to choose or offered the option of how to work with the activity (Tomlinson & Imbeau, 2010). Above all, TA allowed learners to demonstrate a level of competence that presented inclusivestrategies for learning money concept. For TC and TB, to make learning stimulating, games were the form of the strategy when teaching mathematics. TC did a game with fractions. She asked learners in groups to build these fractions – one third, one fifth, half and quarter – usingthe building blocks. TB used a game to explain the concept of time. She would call the time and learners showed the time using their bodies. Games are pleasing to learners' sense of fun and play, while they offer the chance for instructors to differentiate instruction (van Eck et al.,2017). With regard to instructional methods, all teachers gave instructions to the whole class.

In addition, Tomlinson (2017) notes that instructions can be given to learners according to their levels. All teachers acknowledged the importance of a conducive environment for teaching.

6.3 Recommendations and Areas for Future Research

Although the LoLT in all the schools involved in this study is isiXhosa, it is evident that teachers should not ignore the real-life aspects that the learners bring into the classroom. Learners learn from their knowledge and advance to the unknown based on their pre- knowledge. This should be the route that the teachers should take. This means that the teachersshould allow learners to bring the English terminology for mathematics into the classroom butmake a way to scaffold them into the LoLT which is isiXhosa. To enable learning in their classrooms, teachers need to understand both isiXhosa and English terms for mathematics concepts.

Teachers need to be trained and made aware that DI is based on a modification of four elements.I believe that the training will be most effective if the teachers are made mindful that their understanding of the learners directs these modification needs based on the learners' readiness, interests and learning profiles (Tomlinson & Imbeau, 2010). Therefore, training for teachers should focus on how to implement DI strategies. They should be provided with practical models for applying this strategy in their classrooms. The study has revealed that teachers areaware of differentiation, a concept mentioned in recent policy documents, yet they are unsurewhen it comes to putting it into practice.

6.4 Limitations of the Study

This study was based on four Grade 3 teachers from different schools. My findings cannot be generalised as I did not deeply explore other schools and other grades. Initially, this study intended to focus on six teachers but due to the time factor and the restrictions of my workload,this was not feasible. The visits to the schools were also affected by Covid-19 which restrictedface-to-face interaction. This resulted in having a Zoom interview with TD as she was not feeling well. I also wanted to have a group interview but two of the participants were not comfortable engaging in a group interview. They then asked not to be in the group interview, hence, I resorted to doing individual interviews with them. Despite the limitations listed above,I believe that this study will help teachers better understand how to implement DI.

6.5 My Reflections

This study was carried out during the difficult time of Covid-19 when we needed to maintain social distancing. My proposal was accepted in June 2021, but I had to wait for ethical clearance from the university to be granted permission by the schools' gatekeepers, particularly the principals of the schools and the provincial office. The ethical clearance from the university took about three weeks and the permission from the provincial office took two weeks. I foundthe whole process somewhat distressing. For instance, I could not get to the schools and start collecting data before the June holidays. Instead, I had to wait for the schools to open in July. The waiting was painful as I was idle and watching time pass. Moreover, I had to change supervisors. This affected me emotionally and slowed down my progress.

I was only able to start my study in August because the teachers did not want me to visit themin the first two weeks of the school opening. I began by giving them the questionnaires and a week to respond to them. After that, I negotiated with the participants to observe the four teachers from four different schools. I asked to have interviews with them which went well andsmoothly. The participants enjoyed the sessions and they felt comfortable during the interviews. For some reason, I was a bit nervous to do the interviews, but I began to relax as the sessions went on. I feared that I might ask questions that would undermine my participants' integrity but my participants' cooperativeness during interviews made me feel good. Three interviews were face-to-face and only one participant had to do a Zoom interview.

The data that I generated was very rich. I transcribed observations and interview data manually using Excel. I discovered that it was a very tedious process. Nonetheless, I was able to get an opportunity to internalise my data.

Lastly, the research process made me more aware of the importance of the support that learners need to be successful. It also made me mindful of the importance of intervention tools that the teachers can use, such as pre-assessments, scaffolding and mediation. Besides these, creatinga fun classroom atmosphere which optimises learning situations is also a key component. I have also realised that teachers need to be part of a community of practice, even though that might be challenging, and the four teacher participants in my study would be ideal as they arewilling to do so.

6.6 Conclusion

The significance of this study is that it offers an insight into how teachers implement DI practices in their classrooms when teaching mathematics. This research also notes the importance of having teachers undergo training to be made aware that DI is based on a modification of four elements. Also, in the study, it has been highlighted that teachers should be made mindful that the adaptation of the four elements is directed by the teacher's understanding of learners' needs based on learners' readiness, interests and learning profiles. The study has brought to light that ToPA is not only about understanding the teaching of mathematics as an activity but as arrangements, whether constraining or enabling as *doings* (actions, distribution of resources, space and time), *sayings* (ideas, thinking and language) and *relatings* (relationships among the humans and between humans and non-humans such as resources). The findings from the study showed that the *sayings* in mathematics language hadconstraining elements. I also noticed that learners would rather say mathematics terminologiesin English before saying it in isiXhosa, the LoLT in the FP. At this point, it seemed that Englishwas enabling for learners. With training focused on what DI is and how to implement it in classrooms, teachers will be well-equipped to embrace diversity and IE in their schools.

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APPENDICES

Appendix A: Ethical clearance

RHODES UNIVERSITY
Where leaders learn

Rhodes University, Education Faculty
Research Ethics Committee
PO Box 94, Makhanda, 6140, South Africa
Tel: +27 (0) 46 603 8393
Fax: +27 (0) 46 603 8028
email: e.rosenberg@ru.ac.za

https://www.ru.ac.za/researchgateway/ethics/

18/06/2021

MRS Nomzamo Jack

Education Department

N.Jack@ru.ac.za

Dear MRS Nomzamo Jack

Your application An exploration into how teachers implement differentiated instruction teaching practices: A case study in Grade 3 mathematics classes., 2021-4968-6067has been reviewed by the Education Faculty Research Ethics Committee [EF-REC].

Ethics approval has been granted pending the required Permission Letters being obtained from the organisation(s) listed in your application.

Eastern Cape Department of Education

School Principals

Your application can be downloaded as a PDF version and forwarded with your permission letter request. Please refer to the Applicant User Guide for how to do so.

Please forward the required permission letter/s, once received, to the EF-REC Chair (E.Rosenberg@ru.ac.za) and to the Education Research Ethics Coordinators (g.celakana@ru.ac.za; s.mangale@ru.ac.za) in order for your approval to be finalised.

Sincerely

E Rosenberg

Professor Eureta Rosenberg

Chair: Education Faculty Research Ethics Committee

Appendix B: Eastern Cape Department of Education Ethics Form

Province of the
EASTERN CAPE
EDUCATION

APPLICATION TO CONDUCT RESEARCH IN THE EASTERN CAPE DEPARTMENT OF EDUCATION

THIS APPLICATION FORM MUST BE COMPLETED AND SUBMITTED IN HARD AND ELECTRONIC COPY TO:

The Director: Corporate Planning, Policy, Monitoring and Research Coordination
Eastern Cape Department of Education
Private Bag X 0032
Bhisho
5605 (Postal address)

OR

Fax to: 086 759 7182

OR
email: shepherd.mutangabende@ecdoe.gov.za
cc: funciswa.pakade@ecdoe.gov.za/
tanyaradzwa.mazaiwana@ecdoe.gov.za

OR

Deliver to
Steve Vukile Complex
Zone 6
Zwelitsha
5608 (Physical address)

Enquiries: Shepherd Mutangabende
Tel: 040 608 4537/4773

CHECKLIST – Please ensure all documents are attached	
Departmental Application Form	
Proposal as approved by relevant institution	
Research instruments	
Ethical Clearance Certificate	
2 slides presentation for the Research Committee	
Researcher's Curriculum Vitae and/or Institution's Profile	

NB.: The Research Committee meets on the last Thursday of each month, complete application documents must reach the office 7 working days before that, otherwise they will be in the agenda of the following month.

PGDP EASTERN CAPE

Ilizwe elikuqambileyo!

building blocks for growth

EASTERN CAPE DEPARTMENT OF EDUCATION
RESEARCH APPLICATION FORM

SECTION A TO BE COMPLETED BY RESEARCHER

1. PARTICULARS OF THE RESEARCHER

1.1	Details of Researcher
Surname:	Jack
First Name/s:	Nomzamo
Title (Prof / Dr / Mrs / Ms / Mr):	Mrs
Student/Staff Number (if applicable):	18J0001

1.2	Contact Details
Institution/Home Address	Postal Address (if different)
Corner Grey Street and Somerset Street	
Makhanda	
Postal Code: 6139	*Postal Code:*
Contact No.: 0466038388	Fax No: 0466228028
Email address: n.jack@ru.ac.za	
Preferred method of contact and publication for website:	Email x / Contact No. / Fax

2. DETAILS OF THE PROPOSED RESEARCH

2.1	Level of Study (place an "X" in the appropriate column)	
Honours	*Masters*	*Doctorate*
	X	
Other (specify):	N/A	

2.2	Full title of Thesis / Dissertation / Research Project (attach detailed research proposal) Application will not be considered if proposal is not attached
An exploration into how teachers implement differentiated instruction teaching practices: A case study in Grade 3 mathematics classes.	

2.3 Brief description of proposed Research Attach 2 slides PowerPoint presentation to be presented to the Research Committee
The Presentation must include the following: **Name and Surname of the Applicant** • Institution: • Type and level of Study: • Field of Study: • Research Topic: **Summary:** Brief background including the purpose/aim of the study. **Problem Statement:** **Objectives of the Study:** **Methodology:** **Sample:** **Ethical consideration:** **An example/format of the Presentation:** **Name and Surname of Applicant** 
2.4 Value of Research to the Eastern Cape Department of Education
The potential value of this study is to enable mainstream Grade 3 teachers to reflect on their perceptions of differentiated instruction. It is hoped that their awareness of differentiated instruction will be expanded, particularly how this teaching approach is embedded in inclusive education.

2.5	Particulars of Affiliated Organisation (if applicable)
Name of Organisation	N/A
Position	N/A
Head of Organisation/Research Promoter	N/A
Contact Number	N/A
Email Address	N/A

2.6	Student and Postgraduate Enrolment Particulars (if applicable)
Name of institution where enrolled:	Rhodes University
Faculty:	Education Faculty
Department:	Education department
Name of Supervisor:	Mrs Bev Moore

3. RESEARCH INFORMATION

3.1. District where research will be undertaken:
Institutions where research will be undertaken

Name of Institution	*Type of Institution (primary school, secondary school, technical school, ECD centre, LSEN, FET college)*	*District*
Fikizolo	Primary school	Sarah Baartman
Samuel Ntsiko	Primary school	Sarah Baartman

If Head Office/s (Please indicate Chief Directorate/s and Directorates)

3.2. Total number of learners and staff to be involved:

	Learners	Educators	Principals	Support Staff	Administrative Staff	Lecturers	Other (specify)
Number	90	3	3	N/A	N/A	N/A	N/A

3.3. Time of day that you propose to conduct your research. *Please mark with an "X".*

School Hours	*During Break*	*After School Hours*
X		X

3.4. Expected date of commencement of study (DD/MM/YYYY): 29 July 2021.

3.5. Expected date of completion of study (DD/MM/YYYY) 28 February 2022

4. FUNDING INFORMATION

4.1 Did you receive a bursary from the ECDOE? No
4.2 Details of the bursar/funder/sponsor:

SECTION B

TO BE COMPLETED BY THE UNIVERSITY/INSTITUTION WHERE THE RESEARCHER IS REGISTERED FOR RESEARCH

Application to access Eastern Cape schools for research purposes

This form is to be completed in any of the following three cases:

A. A representative of the Research Body or any institution which commissioned the research
B. Student undertaking an Honours, Masters or PhD within Eastern Cape school/s
C. Academic undertaking research in Eastern Cape school/s
D. Academic applying for group project undertaken by a number of students within a particular programme in Eastern Cape schools (for example for Honours level research project)

1) Name of Institution	Rhodes University	
2) Type of application (See above and indicate one)	A. Representative	
	B. Student	Masters
	C. Academic	
	D. Group project	
3) Name of individual (representative)/student/academic/ group project coordinator	Nomzamo	
4) Student number/ Staff number	18j0001	
5) Qualification (where applicable, or indicate if not for qualification purposes)	Masters	
6) Title of research: An exploration into how teachers implement differentiated instruction teaching practices: A case study in Grade 3 mathematics classes.		
7) Supervisor/s' names (where applicable)	Mrs Bev Moore	
8) Contact email for (A) Representative, or (B) supervisor, or (C) academic researcher, or (D) programme coordinator (as applicable)	b.moore@ru.ac.za	

The completion of this form indicates that all the institution's processes for proposal approval, Ethical clearance or any other processes not mentioned herewith, have been followed.

Reference number and documentary proof of approval of the proposal and Ethical Clearance Certificate must be attached.

Ref number: .....

This entailed ensuring that the proposed research meets the criteria of, inter alia:

- Sensitivity - towards participants and institutions, including issues of informed consent and ethical considerations around beneficence and non-maleficence;
- Significance – that the study has merit and meaning and has a contribution to make;
- Accountability – that the researcher understands the responsibilities associated with research in schools and takes issues of validity, reliability and trustworthiness into account;
- Appropriateness – that the research design is aligned to its intentions and to the context of the study.

Date	28 June 2021
Institution's Research Office Details	Ethics Coordinator: Mr Siyanda Manqele Tel: 046 603 7727 Email: s.manqele@ru.ac.za
Institution's Stamp	RESEARCH OFFICE ETHICAL REVIEW 28 JUN 2021 RHODES UNIVERSITY P.O. BOX 94, MAKHANDA, 6140
Signature of an Authorised person	
Title and name of an Authorised Person	Mr. Siyanda Manqele

The completion of this form indicates that all the institution's processes for proposal approval, Ethical clearance or any other processes not mentioned herewith, have been followed.

Reference number and documentary proof of approval of the proposal and Ethical Clearance Certificate must be attached.

Ref number: .....

This entailed ensuring that the proposed research meets the criteria of, inter alia:

- Sensitivity - towards participants and institutions, including issues of informed consent and ethical considerations around beneficence and non-maleficence;
- Significance – that the study has merit and meaning and has a contribution to make;
- Accountability – that the researcher understands the responsibilities associated with research in schools and takes issues of validity, reliability and trustworthiness into account;
- Appropriateness – that the research design is aligned to its intentions and to the context of the study.

Date	28 June 2021
Institution's Research Office Details	Ethics Coordinator: Mr Siyanda Manqele Tel: 046 603 7727 Email: s.manqele@ru.ac.za
Institution's Stamp	RESEARCH OFFICE ETHICAL REVIEW 28 JUN 2021 RHODES UNIVERSITY P.O. BOX 94, MAKHANDA, 6140
Signature of an Authorised person	
Title and name of an Authorised Person	Mr. Siyanda Manqele

Appendix C: Department of Education MEC consent letter

Consent letter to MEC

Education Department

Rhodes University
PO Box 94

Makhanda

6140

21 April 2021

The Member of the Executive Council

Steve Vukile Tshwete

Education Complex

Zone 6

Zwelitsha

Dear Sir/Madam

Requesting to permission to conduct academic research within the Makhanda District

My name is Nomzamo Bridget Jack. I am presently registered as a part-time Masters' student doing a full thesis in Mathematics Education at Rhodes University. My student number is 18j000. I hereby request permission to conduct a research study at the following schools: Fikizolo Primary School, Samuel Ntsiko Primary School, N.V. Cewu Primary School, D.D. Siwisa Primary School, C.M Vellem Primary School, Archie Mbolekwa Primary School, Makana Primary School and Andrew Moyake Primary School.

The focus of my study is an exploration into how teachers perceive and implement differentiated instruction in their mathematics classroom, therefore, the provisional title of my study is: An exploration into how teachers implement differentiated instruction: A case study in Grade 3 Mathematics classes. My study will include administering questionnaires,

interviews, observation and document analysis. With the exception of classroom observations, the other data collection methods will be done outside class time but within a school environment. As such, I will not interfere with teacher-learner contact time.

I intend to audio record the lesson proceedings. During this time, I will also take notes of my observations. Prior to the commencement of the study, I will explain to the teachers and parents what this study entails. However, if participants are uncomfortable with audio recording, I will respect their wishes and take field notes only.

The data that I gather will be used to write a thesis in order to complete my Master of Education qualification.

Should you have any enquiries during or after the study, please do not hesitate to contact me or my supervisors using details provided below. The ethics coordinator Siyanda Manqele at s.manqele@ru.ac.za or 046 603 7727, may also be contacted.

I hope this request will receive your favourable consideration. I look forward to hearing from you.

Yours faithfully

Nomzamo Jack

O832441922 / 0615109615

n.jack@ru.ac

Supervisors: Mrs Bev Moore

b.moore@ru.ac.za

Dr Ellison Musara

ellisonmusara@gmail.com

Appendix D: Principal consent letter

Education Department

Rhodes University
PO Box 94

Makhanda

6140

Principal consent letter

21 April 2021

Dear Sir/Madam

Requesting permission to conduct academic research in your school

My name is Nomzamo Bridget Jack. I am presently registered as a part-time Masters' student doing a full thesis in Mathematics Education at Rhodes University. My student number is 18j0001. I hereby request permission to conduct a research study at your school.

The focus of my study is an exploration into how teachers perceive and implement differentiated instruction in their mathematics classroom, therefore, the provisional title of my study is: An exploration into how teachers implement differentiated instruction: A case study in Grade 3 Mathematics classes. My study will include administering questionnaires, interviews, observation and document analysis. Except for classroom observations, the other data collection methods will be done outside class time but within a school environment. As such, I will not interfere with teacher-learner contact time.

I intend to audio record the lesson proceedings. I will also take notes of my observations. Prior to the commencement of the study, I will explain to the teachers what this study entails. However, if participants are uncomfortable with audio recording, I will respect their wishes

and take field notes only.

The data that I gather will be used to write a thesis in order to complete my Master of Education qualification. A report summarising key findings of the research would be provided.

Pseudonyms would be used in writing the report and no data would be traceable back to participants.

Should you have any enquiries during or after the study, please do not hesitate to contact me or my supervisors using details provided below. The ethics coordinator Siyanda Manqele at s.manqele@ru.ac.za or 046 603 7727, may also be contacted.

I hope this request will receive your favourable consideration. Should you have any further questions, please do not hesitate to contact me on the details given below. I look forward to hearing from you.

Yours faithfully

Nomzamo Jack

O832441922 / 0615109615

n.jack@ru.ac

Supervisors: Mrs Bev Moore

b.moore@ru.ac.za

Dr Ellison Musara

ellisonmusara@gmail.com

Appendix E: Teachers' consent form

Education Department

Rhodes University
PO Box 94

Makhanda

6140

29 January 2021

Dear Teacher

Requesting permission to conduct academic research in your classroom

My name is Nomzamo Bridget Jack. I am presently registered as a part-time Masters' student doing a full thesis in Mathematics Education at Rhodes University. My student number is 18j0001 at Rhodes University. I hereby request and seek permission to conduct a research study in your classroom.

The focus of my study is an exploration into how teachers perceive and implement differentiated instruction in their mathematics classroom, therefore, the provisional title of my study is: An exploration into how teachers implement differentiated instruction: A case study in Grade 3 Mathematics classes. My study will include administering questionnaires, interviews, observation and document analysis. I intend to audio record the lesson proceedings. I will also take notes of my observations. I am inviting you to participate in my study as you are an experienced Grade 3 teacher. Therefore, you are well positioned to provide useful information based on your own experiences. If you are willing to participate you will receive a questionnaire, be observed during one lesson and interviewed about your thoughts and practices regarding differentiated instruction. I would like to work with you as I conduct my research. I will work according to your school timetable and the times that will be convenient

for you for observing lessons and conduct an interview with you.

It is important that you understand that this is not an evaluation of your performance but rather about me seeking assistance from an experienced teacher like you. As such, I undertake to uphold your autonomy and will keep observations and interviews in the strictest confidence. You are free to withdraw from the research study at any time without negative consequences to your person. In this regard, you will be asked to complete a consent form.

It is against this context that I respectfully invite your participation and assistance in my research. Should you have any queries please feel free to contact me at (O832441922 / 0615109615) or (n.jack@ru.ac.za). My supervisor, Ms B Moore (083 797 3378) and the ethics coordinator Mr S Manqele may also be contacted. at s.manqele@ru.ac.za or 046 603 7727, may also be contacted.

I hope this request will receive your favourable consideration. I look forward to hearing from you.

Yours faithfully

Nomzamo Jack, Masters' Research Student

Participant declaration

Declaration

I .....(full names of the participant)

Hereby, confirm that I understand the content and nature of this research project. I understand that I reserve the right to withdraw from this research study project at any time.

…… …….

Signature of participant Date

Appendix F: Parents' consent form isiXhosa version (Incwadi yemvume eya emzamlini)

Education Department

Rhodes University
PO Box 94

Makhanda

6140

21 April 2021

Mzali Obekekileyo

Isicelo sokwenza sokufumana imvume yokwenza uphando kwi gumbi lokufunda elinomtwana

Igama lam ngu Nomzamo Bridget Jack. Ndenza izifundo zeMasters e Rhodes University kwicandelo le Mfundo kwicala lezibalo. Inombolo yam yokuba ngumfundi ithi18j0001.Ndicela ukufumana imvume yokokuba uvumele umntwana wakho abandakanyeke kolu phando ndizakulwenza eklasini yakhe yebanga lesithathu. Isihloko sophando lwam sithi " Ukujonga okokuba ootitshala xa befundisa izibalo kwibanga lesithathu, bakuphumeza njani ukufundisa benikezela ngemiyalelo eyahlukeneyo ("An exploration into how teachers implement differentiated instruction: A case study in Grade 3 Mathematics classes."). Oluphando luzakube lujolise ngqo kootitshala. Ndizakube ndibajongile ndiqaphela indlela isfundo abasiqhuba ngayo. Umntwana wakho akazikubandakanyeka ngqo, kodwa ubukho bakhe bubalulekile ukuze ndikwazi ukubona indlela asiqhuba ngayo isifundo utitshala. Ngelixesha ndizakube ndijonge utsitshala efundisa ndizakube ndithatha amanqaku okwenzekayo kananjalo ndizakube ndirekhoda amazwi Zonke izimvo nolwazi endizakuluqokelela koluphando luzakuba yimfihlo engqongqo. Akukho nanye indawo apho umntwana wakho ayakukhankanywa kuyo

Ukuba ungathi uvumele umntwana wakho okokuba abekhona eklasini xa ndizakube ndiqhuba uphando, iyakundivuyisa kakhulu loo nto. Ukuba ufuna ulwazi oluthe vetshe ungaqhagamshela

uNkosikazi Bev Moore ongumcebisi wam koluphando kule nombolo 083 797 3378 ukanti ungaqhagamshela uMnu Siyanda Manqele kule nombolo 046 603 7727 ongumxibelelanisi.

Ndiyathemba okokuba esisicelo sakufuman uqwalaselo.

Ozithobileyo

Nomzamo Jack, umfundi wophando lwe Masters

O832441922 / 0615109615 (n.jack@ru.ac.za).

Abacebisi kuphando: Mrs Bev Moore

b.moore@ru.ac.za

Dr Ellison Musara

ellisonmusara@gmail.com

Ivume yomzali

Mna_____, Ndinikezela ngemvume yokokuba umntwana wam,u _____Angabandakanywa koluphando olusisihloko “Ukujonga okokuba ootitshala xa befundisa izibalo kwibanga lesithathu, bakuphumeza njani ukufundisa benikezela ngemiyalelo eyahlukeneyo ("An exploration into how teachers implement differentiated instruction: A case study in Grade 3 Mathematics classes.”) Injongo yoluphando ndiyicaciselwe. Ndiyixelelwe nento yokokuba umntwana wam angarhoxa nanini na ndifuna

_____ _____

Utyikityo lomzali Umhla

Appendix G: Observation schedule

OBSERVATION SCHEDULE

Teacher: **Grade:** **Subject: Mathematics**

Date:

Theory of Practice architectures:

Practice setting: - **Look at the participants, size of the class, number of leaners in the class. The class may be the main space, yet the class may occur outside.**	
Cultural-discursive arrangements: -Look at how is language used. • Is it enabling or constraining? • Where does the language come from? eg. books, text, communication of learners or the teacher. • Who speaks it most/least fluently? • Is there contestation among people involved or affected about the language, or key ideas or importance?	
Material-economic arrangements: - • How is the space of the class used in a lesson? • How are the learners sitting? • Is the educator sitting or moving between the desks? • At what time of the day is the lesson done? • Lesson plan • Why is it done at that particular time? • How is the class arranged? • Is the arrangement enabling or constraining?	

Social-political arrangements: - • How does the educator handle the class in terms of behaviour of learners? • How is the impact of the role as a teacher? Teacher relation to learners. • How does the educator make use of the space? • How is the educator shaping the social	

structure? • Is there resistance, conflict or argument?	
Practice traditions: - • What do our observations tell us about practice traditions in the site, in the sense of 'the way we do things around here'? • Is there evidence of professional practice traditions (not exclusive to this site) – like following an inquiry approach in science teaching, or following a state policy – and do these enable or constrain what participants hope to achieve in this site?	

Adapted from: Kemmis, McTaggart and Nixon (2014, pp. 81-82)

The Practice Architectures Analysis: Table 1

Elements of practices	Practice architectures in the site
Project What do participants – including myself and others – say they are doing, or intend to do, or have done? (Note: different participants and others may answer this question differently)	Practice landscape How do different participants (and others involved or affected) inhabit the site in different ways, that is, interact with different people and objects, and occupy different places and spaces in the site as a whole?
Sayings (communication in semantic space) What do different participants say in the practice as they do it (what language is used, especially specialised language used in this practice)? What ideas are most important to different participants? What language and ideas do different participants use about the practice (especially to describe, explain, and justify the practice before and after they do it)? How are different participants' language and ideas changing?	Cultural-discursive arrangements (Note: one person's *sayings* are also practice architectures that enable or constrain others' *sayings*) Where does this language or special discourse come from (e.g., texts, policies, professional communities, language communities)? Who speaks this language in the site? Who speaks it most/least fluently? Is there contestation among people involved or affected about the language, or key ideas or importance?
Doings (activities, often producing or achieving something, in physical space-time) What are participants doing? Are there sequences or connections between activities? Are ends or outcomes being achieved?	Material-economic arrangements (Note: one person's *doings* may enable or constrain others' *doings*) What physical spaces are being occupied (over time)? Are particular kinds of set-ups of objects involved? What material and financial resources are involved? (Are the resources adequate?)

Relatings (relationships in social space, especially relationships of power and solidarity) How do participants (and others involved or affected) relate to one another? Are there systems of positions, roles or functions? Are relationships of power involved? Who is included and excluded from what? Are there relationships of solidarity and belonging (shared purposes)?	Social-political arrangements What social and administrative systems of roles, responsibilities, functions, obligations, and reporting relationships enable and constrain relationships in the site? Do people collaborate or compete for resources (or regard)? Is there resistance, conflict or contestation? Is the communicative space a public sphere?
Dispositions (habitus; the interactive capabilities of different participants) Understandings: How do participants understand what is happening? Skills: What skills and capacities are participants using? Values: What are participants' values, commitments and norms relevant to the practice (concerning the people and things involved)?	Practice traditions What do our observations tell us about practice traditions in the site, in the sense of 'the way we do things around here'? Is there evidence of professional practice traditions (not exclusive to this site) – like following an inquiry approach in science teaching, or following a state policy – and do these enable or constrain what participants hope to achieve in this site?

Kemmis, McTaggart and Nixon (2014, pp. 81-82)

Appendix H: Interview questions

Interview questions

1. How does the background knowledge influence what/how you teach?
2. How do you present the content of the lesson?
3. How are learners organised in your class?
4. How do you leverage learners' interests in your lesson?
5. Why is learner's readiness and learner profile important?
6. How do you create a safe and inclusive learning environment?
7. What are some of the ways that the learners in your class differ from one another?
8. How are you handling the diversity of learners in your classroom?
9. What kind of assessment are you offering learners in DI practice?
10. How do you manage learning material in your classroom such that each learner is able to access it without chaos?