

**A CRITICAL REALIST ACCOUNT OF THE FACTORS
ENABLING AND CONSTRAINING LESSON
DIFFERENTIATION IN STEM EDUCATION: A CASE STUDY
OF A PRIVATE SCHOOL IN THE EASTERN SUBURBS OF
JOHANNESBURG**

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ABSTRACT

In the past two decades, South Africa's democratic government has prioritised equality, stemming from its history of apartheid and colonialism. This commitment extends to the education sector, where there's a growing emphasis on inclusive education and the need for differentiation – tailoring lessons to accommodate diverse learning needs in mainstream classrooms. However, existing educational research underexplores how teachers go about planning lessons with the aim of differentiating to accommodate their learners' needs. Recognising this gap, this study explores the enabling and constraining factors of differentiation within South Africa's context, particularly in STEM subjects. Through interviews with seven STEM teachers in a private school in Johannesburg's Eastern suburbs, the study delves into the complex interplay of social, agential, and cultural factors influencing differentiation. It draws on critical realism and social realism as supportive theories underpinning the data analysis. This study highlights that teaching is shaped by teachers' experiences within the South African education system, which can either constrain or enable differentiation. Ultimately, this research aims to contribute to the growing knowledge on differentiation for new and existing teachers, aiming to contribute to ongoing discussions on inclusive education and pedagogical practices.

Keywords

Differentiation; Inclusive Education; STEM; Critical Realism; Social Realism; Agency; Teaching Training; Support; Paradigm Shifts in Education; Student-Teacher Relationship

DECLARATION

I declare that this thesis is my own unaided work. It is being submitted for the degree of Master of Education at the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination at any other University. Reasonable care has been taken to ensure that this work is original and does not breach copyright law. The research report has not been taken from other sources except where such work has been cited within the text.

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**A Critical Realist Account of the Factors Enabling and
Constraining Lesson Differentiation in STEM Education:
A Case Study of a Private School in the Eastern Suburbs of Johannesburg**

by

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However, the correction of all errors/missing information remains the responsibility of the author.



G.C. HANNANT (BA HFD)

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LIST OF ABBREVIATIONS

ADHD	Attention Deficit Hyperactivity Disorder
CAPS	Curriculum and Assessment Policy Statement
CR	Critical Realism
DBE	Department of Basic Education
DHET	Department of Education and Training
IEB	Independent Examinations Board
SAGs	Subject Assessment Guidelines
SIAS	Screening, Identification, Assessment and Support
STEM	Science, Technology, Engineering, Maths
TIMSS	Trends in International Mathematics and Science Study

CHAPTER 1

NAVIGATING DIFFERENTIATION IN CONTEMPORARY SOUTH AFRICAN EDUCATION

1.1. Introduction

The current South African education system plans to achieve equality in response to the historical segregation of apartheid and colonialism. One significant pedagogical practice aiming for inclusivity is differentiation, which involves tailoring lessons to accommodate diverse learner needs. However, the enabling and constraining factors of differentiation when planning lessons within the South African STEM classroom context remain underexplored. This research attempts to address this gap by investigating how teachers navigate these constraining and enabling factors to implement differentiation strategies within STEM classrooms.

Despite the national requirement for teachers to differentiate their lessons, the underexplored shared experiences and collaboration often leaves teachers feeling isolated and not equipped to meet the diverse needs of their students. This study aims to fill this gap by examining the real-life experiences of seven STEM teachers in a South African school in Eastern Johannesburg. By delving into teachers' planning processes based on their experiences with their learners, this research seeks to uncover the enabling and constraining factors of differentiation, and how they impact teaching. Ultimately, this study aims to bridge the gap between theoretical discourse and classroom realities, offering insights to support new and existing teachers towards their goal of inclusive and effective teaching strategies.

1.2. Background to the Study

Contemporary South Africa aims to achieve equality, the opposite response to the segregation endured during apartheid and colonialism. As a result, the South African education system plays a part in aiming for that quality, with one of the practices being that of implementing differentiation within the classrooms spaces. This section highlights how important it is that researchers study how factors within the South African context enable and constrain differentiation, to the benefit of new and existing teachers who are expected to make the pedagogical choice of differentiating during their lesson planning.

Differentiation, which is described as the varying of lessons to reach a wider range of learners in a mainstream setting, is an expectation placed on a teacher, aimed at meeting the requirements of Inclusive Education laid out in the South African Constitution, which stipulates equality. The idea of differentiation is to cultivate a wider reach of knowledge acquisition within mainstream spaces regardless of learners having varying barriers, needs and social backgrounds. Inclusive education, briefly, is not just formal access to education, but also the access to knowledge in these spaces (Morrow, 2007).

The responsibility of wide-reaching knowledge acquisition is placed on the shoulders of teachers, with a valuable teacher being the one who can differentiate their lessons in mainstream schools, reaching a wide variety of learners with varying needs, barriers, and abilities. This being said, differentiation becomes a personal journey, which alters the very personality a teacher is required to develop within their classroom spaces, influenced by their experiences with learners. This openness to alter the way they approach lesson planning is a vital part of differentiation, as it requires them to be willing to work in an environment that is constantly in a state of flux, as each lesson is required to meet the ever-changing needs of learners.

Within this research, I interrogated the ‘real’ experiences of teachers, drawing from critical realism and social realism, to display how differentiation is either constrained or enabled by institutions, enabled by agency and teacher training, and ultimately scaffolded by supportive environments and access to resources which some schools may not have access to.

In this study, I examined how teachers’ ‘real’ experiences affect differentiation. I used critical realism and social realism to show how institutions can either constrain or enable differentiation. In addition, I witnessed how differentiation is enabled with support that comes from teacher agency, training, and supportive environments with access to resources, which, unfortunately, not all schools may have. Further, I unpack how differentiation is constrained by the norms and standards of society’s structures and institutions which make it a challenge for teachers to practice differentiation in a manner demanded by the Constitution. Herein, are the experiences of seven different STEM teachers and their experiences with the South African education system, not just as teachers, but as individuals who were themselves learners in schools and students at tertiary institutions.

1.3. Problem Statement

Within South African schools are teachers who are expected to differentiate their lessons. This can be challenging considering the varieties in social backgrounds and identities of learners, causing their learning needs and barriers to be just as diverse. Being a part of society, teaching and learning is directly impacted and influenced by the structure it falls within, with institutions, norms and practices that enable and constrain differentiation. Teachers are experiencing each of these factors that enable and constrain differentiation within South African spaces, but the bank of evidence of their practices are not engaged with in a way that can be useful to teachers in training or teachers who need support and guidance. There is a need for evidence of differentiation to be shared amongst teachers teaching in a South African context.

The Trends in International Mathematics and Science Study (TIMSS) aims at assessing South African learners' results compared to 38 other countries across the globe. South Africa, according to TIMSS (2019), is ranked one of the lower performers in STEM compared to the other countries. Thus, there is a dire need to reflect on how progress techniques like differentiation can address learner needs, considering these unfortunate results. Fortunately, differentiation within a STEM environment has often been described as possible. Palinscar et al. (citing Kugelmass, 2009) determined that learners with a variety of learning needs does not interfere with how learners can still learn complex, scientific phenomena because STEM requires you to use a variety of teaching methods to expose learners to the very practical applications of each subject. Therefore, the practical, applicatory nature of STEM subjects enables differentiation.

There is a need for teachers to begin sharing their experiences so that teachers in training and existing teachers have something they can refer to when they are implementing differentiation. Further, Erduran and Msimanga (2014), who focus on the growing need for STEM differentiation experiences, attest that, "The development of the evidence pool on science teacher education in South Africa will facilitate the attainment of curricular goals through supporting and enhancing science teachers' pedagogical practices" (Erduran & Msimanga, 2014, p. 43). If the development of differentiation within STEM classrooms means that more evidence of it taking place needs to grow, this research serves the purpose of bringing awareness of what differentiation can look like to new and existing teachers. The purpose of

this study was to study teachers and their differentiation practices, witnessing how differentiation is enabled and constrained within the context of a South African school.

1.4. Rationale

The rationale for this research paper arose from the need for differentiation to be implemented in South African schools by STEM teachers and teachers alike. Erduran and Msimanga (2014) highlight the challenge faced by South African teachers who lack resources and shared experiences of differentiation, leaving them feeling isolated when they are expected to differentiate in their classrooms—as if they are the only individuals doing so. Consequently, when policies such as *White Paper 6* (Department of Education [DoE], 2001) and *The Policy on Screening, Identification, Assessment and Support (SIAS)* (Department of Basic Education [DBE], 2014) expect teachers to differentiate their lessons, teachers do so without adequate means to understand the possibility of differentiation within the South African context. As a result, teachers face constraints by different structures within society, and struggle to enable differentiation, even if they have the capabilities to do so.

Therefore, this study aimed to address these challenges of a lack of contextual identification of the factors that constrain and enable differentiation by conducting a case study involving seven STEM teachers. Unlike studies that only observe classroom lessons, this research focused on unpacking the planning process behind teachers' lessons, exploring how their experiences shape their teaching styles, and examining how they collaborate with students to create meaningful learning experiences. Its aim was to go beyond the existing theoretical ideas and delve into the practical examples of differentiated lesson plans. The rationale behind this study is thus, the need to contribute to the bank of evidence of differentiation in a South African context.

1.5. Research Questions

Research Question

What factors enable and constrain lesson differentiation in STEM Education?

Sub-Research Questions

- What methods, techniques, practices and/or support structures do teachers utilise to differentiate lessons to accommodate various learning needs?

- What experiences of teaching are teachers exposed to with learners to create lesson plans that they believe will enable learning throughout each of their classes?
- How do teachers use their experiences of learner needs to create lesson plans that cater for all needs without isolating any learners?

1.6. Aim of the Study

Through an exploration of teachers' reflective practices when planning how to differentiate lessons, this study embarked on a case study aimed at discovering effective teaching methodologies and pinpointing potential avenues for refining differentiation within South African educational contexts. By combining the theoretical underpinnings that both enable and constrain differentiation with the lived pedagogical experiences and lesson planning processes of teachers, this research aimed to provide experiential examples of teaching practices within the unique, diverse context of South Africa. Through this approach, the study seeks to bridge the existing gap between theoretical discourse and practical application, engaging with the interplay between educational theory and classroom realities.

At its core, this research aims to serve as a contribution to the development of resources and shared experiences that can serve as tools to support teachers in the implementation of differentiation. Through the combination of theory and practice, it is imagined that this research will not only contribute to the existing research surrounding differentiation but will also offer practical experiences to the challenges encountered by teachers in their quest to deliver adequate instruction tailored to the diverse needs of their students in the South African context.

1.7. Conclusion

There are two different parts to this research, one encompassing the theory outlining existing knowledge and gaps in said knowledge, and the methods used to investigate the gaps in knowledge. The second part of this research is an extensive outline of the results of this research following seven interviews, and a way forward for future research. Chapter two highlights the theory existing related to differentiation, discussing ideas that centre learners in classrooms, and how teachers can be best prepared to differentiate in mainstream spaces. Chapter three provides an in-depth understanding of the use of the Social Model approach addressing the need for social identities to be a part of teaching and learning and, as a result, became a foundational framework for how I planned, researched, and developed this research report—with equality and inclusive education in mind. Chapter five is the main portion of this research, summarising and reflecting on the results from seven interviews, highlighting the factors that

enable and constrain differentiation when planning lessons. Chapter six rounds off this research report, using current South African trends in results to justify the need to incorporate differentiation into lesson plans, describing the need to further this research by interviewing more people in more spaces with the end result of meeting the needs of as many learners in schools as possible.

Chapter Two situates differentiation within the South African context. Differentiation, like past education theories, has become a foundation for lesson planning, but framed around emphasizing equality and social justice. After apartheid, which enforced segregation and unequal education access, post-apartheid laws promote equality, requiring teachers to use differentiation to meet learners' needs—envisioning a future where education provides not only physical access to schools but also access to knowledge. However, the literature in this chapter discusses how challenges do still exist. South African teachers often feel unprepared due to inadequate training and experience prior to formal, professional teaching. The literature reveals teachers who work in isolation, unable to share their experiences, which hinders effective differentiation as teachers do not actively engage and collaborate with other teachers in efforts to find out what works, and deal with what does not. This research fills a gap in existing literature by providing practical examples of differentiation in South African classrooms and complementing theory with teacher experiences to discuss factors that enable or constrain differentiation and ways to address them.

Chapter three and four highlight the theories involved in this research report, relying on the social model approach, critical realism and Archer's Morphogenetic social realism model to account for the experiences of teachers in relation to teaching and learning. These chapters explain the process that was taken to identify the social experiences and interactions of teachers and their learners that equipped them with the understanding of how and why they needed to differentiate their lessons. It also foreshadows the format of the results of this research report, relying on structure, culture and agency, all theorised by Archer, to display the interrelated nature of all three of these aspects and how they influence a teachers' ability to differentiate in a school environment.

Chapter five is the core chapter of this study, highlighting and reflecting on the results from seven interviews conducted with STEM teachers at a private school in Johannesburg, East. This chapter encompasses five different subchapters each relating to the variety of experiences of teachers. Touching on standardisation, private schooling versus public schooling and the

harsh realities of time constraints that teachers face, this chapter paints a picture of the constraining factors of differentiation by structures that are the very foundation of education. The culture of schooling environments and the support required is also discussed, detailing how teachers can be empowered in their spaces of work through professional development, support if struggling and broad agreement from all involved in schooling to understand and embrace differentiation for the betterment of learning. This chapter ends by engaging with what teachers mean when they describe a learner-led classroom, offering advice and suggestions on the rethinking of lesson plans to grant learners the agency they need to survive beyond school. This chapter unpacks Archer's structure, culture and agency, detailing a chronological understanding of how the very foundations of education impacts even a single learner in every school.

The concluding chapter of this research report, titled "Conclusions and Recommendations," addresses the current state of South African education statistics and underscores the consequences of inaction by stakeholders in educational spaces on learners and their futures. It emphasizes the need for future research to actively involve learners, teachers, parents, and school governing bodies to ensure that teachers do not work in isolation and that challenges in differentiation are viewed as opportunities for growth rather than individual failures on the part of a teacher. The chapter concludes by highlighting the dynamic nature of this research, underscoring the need for ongoing inquiry, as learners and their experiences are continually evolving, therefore, so should educational theories and the research done on it.

CHAPTER 2

LITERATURE REVIEW

2.1. Introduction

Differentiation is a buzzword within educational practices—it is a strategy aiming to bridge the gap between learners who do not understand and learners who do. Studies exist which depict the need for differentiation within classrooms, encouraging teachers in training to understand the history and theory behind it, in the hope that they are going to understand why it is important to implement it within South African classrooms. This literature review highlights how the promotion of differentiation in education has become a focal point of structures, individuals, and policies, clearly describing why it needs to take place. I also paint a picture of what differentiation looks like in STEM in the current context of South Africa. This study was necessary as in its aim to explore the need for teachers to share their experiences of differentiation, it hopes to highlight the factors that enable and constrain differentiation. Within this literature review, I will explore differentiation in the context of South Africa, and the needs South African teachers have concerning adequate teacher training and support under the expectations of ensuring differentiation happens in their classrooms.

2.2. Promoting Learner-Centred Tailoring of Lessons: Differentiation vs. Access

Educational theories are dynamic in nature, always changing to meet the needs of teaching and learning which changes as rapidly as societies do. As societies evolve and spaces change, learner needs change as well and, with them, educational theories. As a result of the vast inequalities within various societies stemming from eras of colonialism, apartheid and mass discrimination, differentiation arose as a technique to address inequalities by centring lessons around individual learner needs, regardless of their differences in backgrounds and experiences. As a result, I will highlight how the strategy to combat inequalities has placed the responsibility on teachers to differentiate their lessons within mainstream spaces, to accommodate and meet the needs of all learners. This reliance on differentiation is important to ensure learner equality, positioning them as equal to their classmates once they leave school. With differentiation being an expectation, this great responsibility being placed on teachers means that they now require access to resources and shared practices that allow them to

understand differentiation in the context of South Africa a bit better—this, unfortunately, is not so easily accessible, as discussed below.

The history of educational paradigms spans decades. Ranging from cognitivism, behaviourism and constructivism to social culturalism and embodied cognition, each of these theories paints an image of the way education was disseminated in each era. Educational theories influence the pedagogical choices a teacher uses to plan their lessons, how they issue instructions and the techniques they use to assess learner understanding. As a result of relying on one manner of thinking, learners who were unable to learn according to the chosen developed theory of their era were classified as ‘unteachable’. Through doing so, two categories were developed: (1) ‘teachable’ learners and (2) learners who were considered ‘unteachable’. As knowledge acquisition became standardised, learners who were unable to learn from singular teaching practices were isolated.

However, eras have evolved and with life-changing protests, independence movements, and overthrowing of segregationist ideologies throughout history, there developed an increased awareness of the importance of social justice and inclusivity within society. Authors such as Lingard and Mills (2007) argue that one manner of teaching can no longer be the major leading factor teachers use to create lessons because “issues of pedagogies, social justice and inclusion cannot be considered in isolation from those of curricula and assessment” (Lingard & Mills, 2007, p. 235). Teachers cannot separate learner identity, background, and experiences as a result of their identity from how they learn and what needs to be taught within a classroom. Lingard and Mills (2007) situate education within the current context of the world, focusing on how social justice and inclusion should not simply be taught as definitions or case studies in schools but should systemically scaffold each decision we make—including our pedagogical teaching choices, curriculum, and assessment. Social justice, according to Lingard and Mills (2007), is closely linked to inclusive education because, just like social justice which aims to address inequalities amongst identities, inclusive education wishes to address inequalities in accessing knowledge in schools. The practice of differentiating lessons, acknowledging the inequalities amongst social identities of learners is a daunting task, and teachers need support—hence, the importance of documenting teacher experiences with differentiation through research.

Lingard and Mills (2007) suggest that educational theories are not the only thing that we need to address in schools, they call this an “education debt” referencing Ladson-Billings (2006, pp.

5) who explains that to address inequalities in schools, we need to look at the curriculum, schooling purposes and assessment. However, what Lingard and Mills (2007) highlight, is that educational theories and practices like differentiation require existing teachers to play a role in developing research that addresses how they make sense of what their learners need. This calls for research that works with and listens to how teachers make use of differentiation in their classrooms. While this research exists within contexts of countries outside of South Africa, this is not useful for South African teachers who need a wealth of resources relevant to the South African context, because it comes with its own factors such as histories, norms, inequalities, and structures that enable and constrain differentiation. Unfortunately, this wealth of resources and collaboration between South African teachers is not as easily accessible, or being practised as widely as it needs to be to benefit teachers. As a result, more research needs to focus on the factors that constrain and enable differentiation for the benefit of teachers in their contexts.

The post-apartheid Constitution of the Republic of South Africa ushered in an era of inclusion, extending to education. Current laws and policies, including *White Paper 6* (DoE, 2001) and *The Policy on Screening, Identification, Assessment and Support* (SIAS) (DBE, 2014), advocate for differentiated lessons to prevent the categorisation of learners as 'unteachable'. Teaching now demands a shift beyond traditional classrooms, requiring teachers to tailor lessons to individual learner interests and experiences rather than treating the class as learners who can all learn in the same way. Abacioglu et al. (2019) assert that effective teaching involves dynamic lesson planning responsive to learners' needs and experiences, requiring teachers to become equipped to deal with constant adaptation to changing and progressing needs. This highlights the importance of collaboration among teachers to address challenges in differentiation, emphasising the urgent need for further research into differentiation practices within South African schools.

While Abacioglu et al. (2019) paint an interesting picture of the dynamic nature of lessons that differentiation requires, what they conclude from their study is that a successful teacher is one that has “perspective taking—the ability to perceive things from a point of view other than one’s own” (Abacioglu et al., 2019, p. 739). Abacioglu et al. (2019) suggest that successful teachers are ones who engage in different contexts, looking at multiple perspectives of their learners, interrogating the multicultural experiences which make up their daily lives, and influencing how they learn. Abacioglu et al. (2019) point out that there is a noticeable gap in teacher success, with successful teachers being ones who are engaging with multicultural experiences, and not ones who are isolated from them. Whilst my research only explored a

private school, this research is still a necessary tool for teachers to engage with the multicultural experiences of South African learners within the South African context.

2.3. Bridging the Gap: Current and Future Visions of Differentiation in South Africa

South Africa boasts a rich history of freedom fighting, strong political campaigns for equality and a constitution that enforces and expects equality. As a result, differentiation is seen as a tool to reach the goal of nationwide equality by addressing and eliminating inequalities in the youth that enter South African schools, in the hope that an equal education will afford them equal successes in obtaining qualifications and jobs after school. Whilst this constitution enables differentiation through its expectations that the process needs to take place, there are constraints that exist as a result of existing societies, norms, and standards. As a result, the factors that enable and constrain differentiation in practice need to be studied, and then shared with other teachers who are under the same expectation, requiring them to differentiate within South African schools.

Idealising a South Africa where inclusive education is a reality and not a utopia has not been a goal that we have reached as yet in South Africa. In an article by Thelma de Jager (2017), she references a study from 2013 which notes that 97% of teachers in South Africa “never or seldom use a flexible curriculum and extra time to accommodate the diverse learning needs of learners” (de Jager, 2017 p. 116). This in part was blamed on inefficient teacher training and a lack of support within education spaces. Hove (2022) notes a similar dissonance in a study almost five years later. Teachers in this study displayed an inability to differentiate their instruction to learners of different learning abilities, allowing us to visualise and understand how we have not progressed within the South African education sphere. This lack of progress constrains differentiation within a South African context, making it important to research and document, because it is a shared experience of multiple teachers spanning years.

South Africa had a vision of equality, and through creating policies that attempted to enable equalities in school, expected teachers to use differentiation to address learner needs. However, there are constraints to this implementation, one being teachers not having the access to resources and shared differentiating practices of other teachers. Kennedy and Robinson (2023, p. 108), exploring the flaws behind the South African curriculum shift, highlight the following,

Govender and Young (2018) showed that down to the classroom level teachers felt they were without any support, not just in terms of training for the new curriculum but also because there were very few resources to help them and very little guidance.

Through highlighting the fact that teachers struggle to enable the new curriculum because of a lack of support and guidance, the necessity of sharing experiences is displayed. Within the South African context there are teachers who have differentiation enabled in their spaces, and in other contexts have differentiation constrained; however, they do not exist in isolation from those who experience similar factors and, as a result, will benefit from shared experiences. To implement a new curriculum and its practices that enable equality of opportunity for learners, teachers need to have a space where they can share their struggles when differentiation is constrained in efforts to develop a collective agency that works around this constraining of differentiation. Further, in contexts where differentiation is enabled, other teachers can benefit from understanding where and how this is possible, making research about differentiation in practice a requirement for the implementation of differentiation.

Erduran and Msimanga (2014) support STEM teachers sharing practices and experiences:

Exchange and communication between science teachers is essential for their learning and subsequent adoption of curriculum recommendations. In other words, it is not sufficient for teachers to work in isolation to adopt new frameworks, particularly those that are conventionally unfamiliar to them. (p. 42)

As we begin introducing new theories, practices and curriculum, teachers who share practices and learn from each other develop the agency to adopt those new frameworks, even if it is new or challenging. If teachers are to be held accountable for upholding differentiation, then they need to be adequately trained and supported enough to know what differentiation looks like in their subject. Teachers receive theory about differentiation but would benefit greatly from real-life experiences documented by other teachers of differentiation in their shared contexts; this is the purpose of this study. This vision of differentiation that the South African Constitution upholds is an idealistic future, one which the learners of South Africa deserve because they have a right to equal opportunity. However, this vision of differentiation is constrained by teachers acting in isolation from each other, experiencing the constraints and enabling of differentiation in their own spaces, without sharing it with other new or practising teachers. As a result, differentiation is not furthered because it is practised as if it were only taking place in one teacher's classroom, as if the context of that teacher is not reflected in the experiences of

others. This slows down the national vision for a future with differentiation because it develops slower when teachers are carrying it out alone.

2.4. The Unmet Need for Teacher Training and Support in South Africa

One of the ideas reiterated throughout the literature documenting differentiation and inclusive education, is the need for more teacher training and support, with many authors discussing how large numbers of teachers in South Africa do not feel adequately prepared to differentiate. Teachers are either vehemently against this change or are nervous about differentiation which has no step-by-step process but is rather a trial-and-error method, attempting to incorporate multiple ideas in lessons to accommodate individualised learning needs. Differentiation can be a challenge and so authors like Tomlinson (2015) suggest that a possible solution to the avoidance of differentiation is to concentrate on teacher training and growth. Tomlinson (2015) states that policies should be created to emphasise teacher development with the result being that teachers who learn and develop new ways of teaching will use those methods in their classrooms and this can lead to academic excellence for all learners. This applies to all teachers, including those who are the focus of this study, STEM teachers.

To teach prospective and current teachers about differentiation, we cannot only rely on existing theory which can be daunting and abstract. Erduran and Msimanga (2014) highlight the need to, “[develop] the evidence pool on science teacher education in South Africa [which] will facilitate the attainment of curricular goals through supporting and enhancing science teachers’ pedagogical practices (p. 543). Erduran and Msimanga (2014) suggest that before we can adequately train teachers, we need to research and have conversations with existing STEM teachers within a South African classroom environment, so we have a pool of evidence on how and when inclusive education can be used. The idea is to identify places where teaching methods vary and understand what factors influence this variation. This knowledge can help create new policies and curricula that support different teaching approaches. This research aims to contribute to that goal – a documentation of the experiences of STEM teachers and their experiences of how differentiation is enabled and/or constrained in their contexts.

De Jager (2019, p. 2) adds, “In addition, Bourdieu’s theory of social capital for teachers (Bourdieu, 1977) postulates that teachers should share information with colleagues and learn from one another when creating differentiated activities.” As highlighted in this quote, a bank of evidence of differentiation within the context of South Africa is useful for other teachers

who can learn from the practices of their peers. This supports the idea that teacher training is not simply student teachers entering spaces watching teachers teach, but rather a systematic documentation of how teachers already teach and the sharing of this knowledge with existing and new teachers. This research was aimed at displaying how teachers experience differentiation, bridging the gap between theory and praxis in the hope that teachers become more keen about sharing their differentiated successes and failures, to encourage a collaborative effort amongst South African teachers. Cultivating an agency in teachers becomes easier to do when teachers have a wealth of resources on which to build as opposed to expecting teachers to do so in isolation.

In an article by de Jager (2017), the following statement is made, “fluency comes with experience” (p. 120). This article discusses how differentiated instruction and learning do not come from abstract theories on teaching but rather from the real experiences of teachers—whether your own or the experiences of another. De Jager (2017) claims that there is often content that needs to be retaught if differentiated instruction is not used because singular ways of teaching rarely reach every learner. However, de Jager (2017) aptly states that time and effective training in developing differentiated activities can avoid having to use more time in future correcting the misunderstandings that learners experience. In de Jager’s (2017) study, the challenges a teacher faces are thoroughly discussed, displaying how teachers are not supported throughout their experiences of developing lessons using differentiated learning. Rather, teachers are aware of what it means theoretically but do not have the support and practical experiences to fall back on. This indicates a need for a handbook of resources to be created, where teachers can support each other by professionally developing themselves through sharing their experiences—more so than reading academic articles that detail differentiated learning as if it is a step-by-step method or procedure.

To conclude, Taba and Elkins (1966) stated decades ago that “teaching in the dark is questionable practice” (p. 23), describing that teaching without understanding learners' prior knowledge and experiences is ineffective, highlighting the importance of contextual learning. Similarly, without a space to explore the experiences of other teachers, particularly in the challenging space of differentiated instruction in South African STEM education, educators may feel unsupported. My study aims to address this by documenting teacher experiences in developing STEM lesson plans, contributing to the ongoing dialogue on effective teaching practices. Recognising that educational theories evolve with changing eras and learners, Archer's social realism highlights the need for teachers to innovate and share experiences –

developing a culture of sharing best practices ensures that teachers are equipped with experiential examples of differentiation alongside their learned differentiation theory, to implement differentiation effectively.

2.5. Conclusion

It is essential that teachers differentiate lessons; however, ensuring that they have access to the possibility of collaborative learning is vital. Teachers cannot exist in isolation from each other, considering that all teachers in South Africa are encompassed under the same umbrella of policies and syllabi. As a result, teachers who are not collaborating do not have access to other teachers who are experiencing the same, or similar experiences of the factors that enable and constrain differentiation. Thus, we begin to realise that the need for research to document differentiation in South Africa is of importance, because it gives new and existing teachers an opportunity to share what is working, and what is not, in order for differentiation to be worked on and improved for nationwide dissemination.

It is important to begin bridging that gap between theory and practice because, as much as learning about differentiation is useful in terms of theory, knowing why and how differentiation is possible is more useful to learners and teachers. Within STEM subjects exist very abstract topics, from microscopic entities to structures like the atom which has not even been seen before. As a result of this abstract nature, teachers are required to make meaningful connections between theory and practice for learners to fully understand the wonders of STEM in the real world. In a similar way, the wonders of differentiation can also be implemented if teachers move beyond just an abstract, theoretical understanding of the practice.

CHAPTER 3

THEORETICAL FRAMEWORK

3.1. Introduction

Throughout the theory portion of this research report thus far, I have often referred to the need for teachers to understand, reference and engage with learner context. As a result, learners and their social identities become foregrounded during the implementation of differentiation during lesson planning, because it is their needs that are trying to be met. Their needs stem from their experiences and backgrounds within societies and other educational spaces, calling for teachers to acknowledge their social identities, and make sure their lessons differentiate using those experiences and prior knowledge. This chapter briefly highlights the importance of using the social model approach. While this approach was developed to identify and engage with disabilities within the educational sphere, it is an important framework to use to understand how inequalities within the lives of learners have their own biases and stereotypes, constraining education. This approach also addresses the need for social identities to be a part of teaching and learning and, as a result, became a foundational framework for how I planned, researched, and developed this research report—with equality and inclusive education in mind.

3.2. The Social Model Approach

The most fruitful classes a learner can be in, are ones that include information that they can relate to—this itself is true of most human behaviour we are more enthusiastic about what we are interested in. Mokiwa (2020) states that teachers need to select interesting, real-world tasks through which science students would experience ‘good’ learning by making classroom science relevant to them and that whatever they learned in class should be applicable to their lives (p. 100). I use this quote by Mokiwa (2020) to introduce this theoretical framework section, because a teacher’s expectation when it comes to differentiation in a STEM classroom is to make the work relatable to learners. As a result, this research required a theoretical framework that considered learners and their positioning within society, guiding teachers to identify the backgrounds and prior knowledge and experiences of learners in order to develop lessons that directly appeal to them – the social model approach.

The social model approach factors in the relationships between ideology and society in a way that scaffolded my research. Developed in opposition to the favouritism of able-bodied and

able-minded individuals, the social model approach pointed out that the ableist beliefs and ideologies of society were the disabling factor of a person with a disability, and not the disability itself. Tregaskis (2002) explains that,

Instead, responsibility for that exclusion is placed at the door of a normalising society that has rigidly developed and maintained structures designed to create a docile workforce (Foucault, 1991, p. 193), and to reward those who most closely conform to socially prescribed ideal models of appearance and behaviour. (p. 457)

Tregaskis (2002) explains that ideologies within society become the standard by which people need to socialise themselves or else risk isolation or exclusion. Due to the vast nature of these ideologies, they become the ‘norm’, unquestioned, spreading to the many people who socially interact within a context or society. This is considered the ‘real’, as Bhaskar (1975) would put it, the mechanisms and structures which often go unquestioned as they are framed as the ‘norm’, which rarely gets questioned, only conformed to. As a result, norms, ideologies, and beliefs gained from these structures and their aligning ideologies and norms impact the way people view themselves and how they interact with others—this is what we ‘observe’.

If these societal norms and ideologies impact the way we believe learners can learn, this has a direct impact on education. Lingard and Mills (2007, p. 235) explain how “[i]ssues of pedagogies, social justice and inclusion cannot be considered in isolation from those of curricula and assessment”, describing how social justice is dependent on pedagogy and epistemology in schools. Lingard and Mills (2007) claim that a teacher’s pedagogical choices hold power if the way we decide how we teach can be directly impacted by the discourses of society into which we are socialised. Whether we are cognisant of or completely unaware of the influence social structures have on us as teachers, society may be influencing the way we believe learners can learn, thus making it important to consider society as a sphere in which our pedagogical approaches to planning a lesson are affected.

The social model approach guides teachers to separate themselves from the biases, stereotypes and perceptions attached to a learner’s identity and/or learning need or barrier. This approach becomes useful because it teaches us that social and cultural factors are not isolated from our classroom spaces, but rather determine the way we move around the world. It also shows how our learners are influenced by social factors beyond their own lives and experiences that impact the way they learn and are taught because they influence the way their teachers are socialised into society. However, to do so, teachers, need to know how to ascertain whether what they

know about this learning barrier or need is because of their interactions with a learner, and not what they learnt outside of the classroom—this is how they begin to differentiate, because of their belief that learners belong.

The social model emphasises the need to consider the context within which one is teaching. Levitt (2017) explains that “the social model would have a greater impact if its emphasis was to more accurately reflect the conditions of the countries in which it is applied” (p. 593). This assisted my research by focusing on questions that I could ask during the semi-structured interviews in the context of a South African school and of South African learners. Differentiation within classrooms is vastly different because with context comes different experiences and exposures. The social model approach assisted my research by guiding my questions in a direction where I considered the challenges, experiences and ideologies present within the vast number of South African spaces.

When conducting this research, it was important to consider that teachers have no single ‘source’ of learning which impacts the way they differentiate their lessons. It was not my intention to find that source or to find out if their main space of learning was at university or through teacher training. The social model approach assisted with widening the scope of understanding and questioning when interviewing teachers, opening the possibility of multiple avenues of researching what factors enable and constrain lesson differentiation.

Theorists discussing the social model emphasise the importance of social structures, such as educational policies, institutional practices, and societal norms, in shaping individuals' experiences and opportunities within mainstream schools. For example, Tregaskis (2002) explains that social structures shape the future of learners by standardising knowledge and labelling learners according to whether they are able to pass those standardised tests. Tregaskis (2002) explains that exclusion on the basis of learners' ‘failing’ needs to be blamed on society which normalises “rigidly developed and maintained structures designed to create a ‘docile’ environment” (p. 457). Considering differentiation, which acts in opposition to passive learning, using the social model approach assisted me with analysing how structural factors influence the manner in which teachers plan their lessons, in an attempt to allow learners to access knowledge regardless of their learning needs or biases.

At the same time, the social model approach acknowledges individuals' agency, and their capacity to act within these social structures, and sometimes even against them. In this study, it allowed me to view how teachers acting in mainstream schools made the active decision to

use differentiation in a manner that opposes standardised teaching and learning, in order to see learners as capable, beyond the rigid idea of passing and failing. Here, the social model approach had research that helped me with interrogating how agency operates within the constraints and possibilities of existing structures.

The social model approach and its research encouraged me to develop a critical perspective on social inequalities faced by learners. It also allowed me to critically examine how a private school is afforded the chance to succeed at differentiation through the distribution of resources and opportunities that financial security can provide. However, it also allowed me to witness how differentiation is enabled and constrained by structures bigger far-reaching than the privilege afforded to private schools, displaying how differentiation is not only enabled by financial security, but is influenced by the greater societies that impact teaching and learning. While designed to focus on the experiences and discrimination faced by disabled people, this framework gave me a fascinating insight into how to assess how social identities and teacher experiences within society affect how they see their learners and plan their lessons.

3.3. Conclusion

The social model approach addresses inequalities within the educational sphere—an area that differentiation aimed at addressing. Learners have their own experiences, contexts, and backgrounds and, as such, require teachers to actively engage with who they are as humans, before planning lessons. As a result, teaching and learning requires teachers engaging with learners as the basis of differentiation.

The social model approach as a framework served as a roadmap for my research, helping me contextualise my study. While I engaged with what makes a lesson differentiated, it was important for me to also engage with the current context of teaching and learning within the South African context. With the guidelines of the social model approach, I could unpack the variety of inequalities and aims at equality within the educational spheres of teaching and learning, engaging with research participants in a way that understood how much impact society and its norms, standards and ideologies have on teaching and learning.

CHAPTER 4

METHODS AND PROCEDURES

4.1. Introduction

Throughout the preparation for the data collection stage, it became necessary for me to use metatheory and data analysis tools that could focus on an in-depth exploration of the way teachers plan their lessons. Being a case study on the vast experiences influencing teachers to plan their lessons in a particular way meant that the theories could not be single-minded in nature. They could not have a finality to them, where I aimed to assess all interviews under one theory or attempted to arrange my research under one theory. As a result, to support the social model theory, I used critical realism and social realism, both of which aim at research that was not finite, research that extensively explored the ‘real’ experiences of teachers, whatever those experiences may be. It was imperative, with the help of these theories, that I needed to work towards my research question of finding out how differentiation is enabled and constrained through their experiences and exposures to being a teacher. This research took the form of a two-part interview, where teachers were requested to spend the first few minutes explaining or displaying how they plan their lessons, followed by an interview that engaged with their lesson planning process. Supported by critical realism Archer’s take on social realism, this research served the purpose of studying how teachers incorporate differentiation into their lessons in the planning process.

4.2. Metatheory – Critical Realism

Using a case study as my research posed a particular challenge—which educational theory do I align myself with? Often, and historically, education has relied on particular major theories such as positivism, constructivism, and cognitivism to encompass all that the relevant era aimed to achieve when it came to teaching and learning. However, with differentiation, which addresses the needs of all learners in a mainstream classroom, I could not rely on one theory to discuss all the responses from teachers. As a result, I needed to find a metatheory that encompassed all responses and narratives from the teachers, in the hope that I could truly answer my question on how differentiation is enabled and constrained in a South African classroom.

Throughout this research, during the stages of preparing a proposal, conducting interviews, and finally writing this research report, I have been advocating for the avoidance of categorising

individuals into groups based on singular ideas. This research is intended to investigate the individual nature of teachers' experiences, to ascertain the real experiences and exposures within education that impact the way a teacher determines the most successful route to differentiation. This meant that when choosing a metatheory to guide my research, I could not choose one that advocated one way of thinking, as this would bring its assumptions and generalisations that served the purpose of proving a particular theory and not developing new information on what, within our experiences, causes teachers to engage with differentiation. Positivism was unsuitable as it supports the idea that once we view it, we know all that there is to know about it. Postmodernism was also not adequate as it states that knowledge is individualised and thus, 'what's true for you may not be true for me'. Empiricism was inappropriate as it theorises that all our learning comes from experiences and observations (Higgs & Letseka, 2022, p. 146).

Critical realism presented itself as a theory that is open-minded enough to bridge theory and praxis—rejecting the reliance on one theory to generalise results and focusing on the dynamic practical nature of teaching within a classroom. Critical realism is described as “a branch of philosophy that distinguishes between the ‘real’ and ‘observable’ world”, stating that “the ‘real’ cannot be observed and exists independently from human perceptions, theories, and constructions about the ‘real’” (Higgs & Letseka, 2022 p. 129). Critical realism distinguishes the real from the observable because within society there are ideologies, beliefs and norms which impact our experiences and paths, but which cannot be observed or pointed out as real, tangible, or visible elements. However, these ‘real’ ideologies as ideologies and structures are strong enough to permeate our lives and impact the way we teach, and this can be observed when discussing exactly why a teacher has chosen to differentiate their lessons in a particular way. By grappling with the behind the scenes and influences behind a teacher’s method of lesson planning, we can engage with the factors, such as society, prior education, experience, culture, and exposure to learners that have a profound impact on the way a teacher now confidently relies on their preferred choice of teaching style and planning.

Critical realism, as described by Sousa (2010), is a working theory—one that does not normalise or generalise the experiences of individuals. Sousa (2010) critiques the social sciences, claiming that there has been a reliance on existing theories, where empirical data is used only if it relates to the theory chosen by a researcher—any experience acting in opposition to these chosen theories is described as ‘dispensable’, or thrown out. Sousa (2010) suggests that critical realism is a working theory because it expects more out of us than simply

generalising experiences into one theory. Critical realism, as presented by Roy Bhaskar, is about focusing on the often pushed-aside concept of ontology which studies the ‘real’ experiences of an individual. Ontology is not simply the experiences one can narrate, but rather a layered structure of reality and the working relationship between what can be observed by individuals and the underlying causal mechanisms that gave rise to those experiences.

Mertens (2009, p. 45) suggests that we ask the following question: “How do we know something is real?” Mertens (2009) and Bhaskar (1975) task us, ontologically, with finding the balance between what is ‘real’ and what is ‘observable’—the joining of theory and practice. What are the real experiences of learner understanding that influence lesson plans? Or what are the experiences with our social identities and how we interact with other social identities that impact the way we view learners and their abilities to learn? These are the questions I aimed to answer during my study.

Critical realism distinguishes three distinct categories necessary for this research—the real, actual, and empirical, as displayed in Figure 1, below.

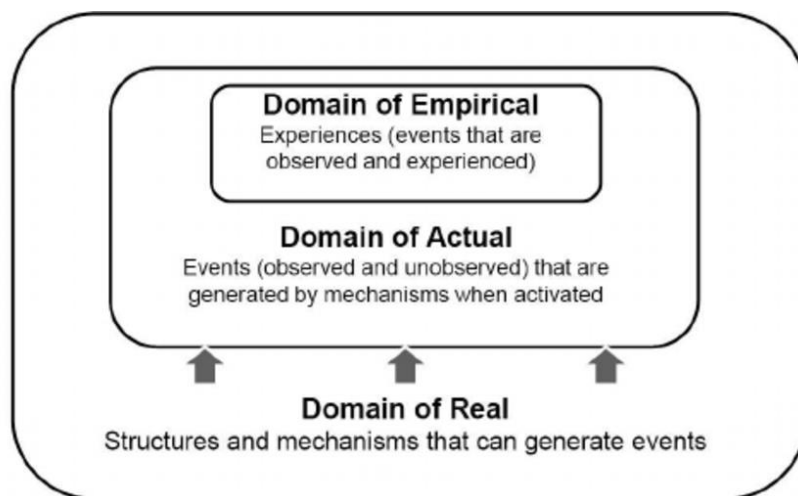


Figure 1 - Radulescu and Vessey, 2009, p. 2

Higgs and Letseka (2022) present us with the link that the ‘real’ includes what we cannot observe, the social structures and mechanisms that exist independently from human theories and senses that have a direct impact on human behaviour. The events that take place because of the ‘real’ structures and mechanisms, whether aware or unaware, happen to be the ‘actual’. The ‘observed’, or the ‘experienced’, often termed the epistemology, is our knowledge of the world—the ideas, experiences, and understandings that we as humans are exposed to and aware of in social structures. The ‘empirical’ is the observed, what we as human beings can discuss and point out as factors impacting our actions. Critical realism is concerned with understanding

that there are structures that exist, which are not observable but have an actual impact on the social world—specifically the way we move around in the world. This metatheory plays a large role in this research because it allowed me to be aware that teachers are individuals who have been impacted by different aspects of society and different ideologies and structures. This metatheory emphasises the need to ask beyond the ‘observed’, attempting to witness where exactly the ‘real’ is, in differentiation.

Critical realism is crucial in education research because it acknowledges the dynamic relationship between teachers and society. Teachers are not passive individuals because they are influenced by and influence society in an ever-changing manner. Educational theories cannot be standardised as education itself is not constant. Bhaskar (1975) explains that there are underlying standards and norms in society that impact human existence regardless of individual perceptions. Critical realism suggests that individuals both reproduce and transform social structures and are shaped by them in return. In education, this perspective is exemplified by the presence of ableism in classrooms, where teachers may hold biased beliefs about the capabilities of learners with conditions like ADHD, dyslexia, or autism. These societal constructions directly impact teaching practices, highlighting the need for critical realism to understand the complexities of educational settings and planning.

Critical realism was necessary for my research because the goal of my research was to add to the growing and developing pedagogical practices of how a teacher enables differentiation in their lessons at a mainstream school in South Africa. Higgs and Letseka (2022) explain that “Critical realism is useful in education in that it opens possibilities for both making current knowledge useful and for propulsion forward towards the trailblazing of new knowledge” (p. 146).

Critical realism guided me to identify the structures that exist regardless of our perceptions and viewpoints and enabled me to identify some of the dynamic structures and mechanisms that may have influenced how teachers plan their lessons. Schools exist with individuals who have perceptions and theories at their foundation, and critical realism acts as a joining of theory and practice in ways not many other metatheories present. Critical realism permitted me the opportunity to identify the practices and link these practices to the theory, ideologies, and experiences within society, culture and social interactions that gave rise to them.

4.3. Research Design

This research was aimed at being an in-depth case study and as such was qualitative in nature. Using qualitative research methods gave me a deeper understanding of what social and agential factors enable and constrain lesson differentiation, in a way that influences how a teacher teaches. It also allowed me to be immersed in the differing knowledge and experiences a teacher has with the factors that were influential enough to impact the way they teach.

Being a case study, it aimed to provide a comprehensive understanding of the experiences of teachers who are using differentiation in their lessons. This research focused on STEM teachers in a private school in the eastern suburbs of Johannesburg, concentrating on seven teachers in order to delve deeply into the unique experiences and intricacies of differentiation. This study, being a case study in nature, gave me the opportunity to identify the manner in which differentiation is enabled and constrained in the context of this private school, offering me a chance to witness lesson planning holistically identifying all the ‘real’ and ‘observable’ experiences of these teachers.

This research on the factors that enable and constrain differentiation was not intended to critique lesson plans or review them, but rather to create a space where STEM teachers reflect on how they differentiation is enabled or constrained within a STEM classroom. The teachers interviewed all teach STEM subjects. Their experiences were of utmost importance as these led to the belief that their chosen method of teaching is the best one for the learners within these teachers’ classroom spaces in a South African context. The nature of a qualitative study, which enables a deeper engagement with participants, allowed me to follow the systematic thinking and preparation that goes into the planning of lessons that STEM teachers use. These teachers displayed their teaching practices in a way that gave me a closer insight into differentiation in a STEM classroom.

4.3.1. Data Collection Site

Data were collected at a private school in the east of Johannesburg, Gauteng from seven teachers in the STEM field, including the following subjects: Mathematics, Mathematics Literacy, Physical Sciences, Further Studies Physical Sciences, Life Sciences and Natural Sciences. Situated in the east of Johannesburg, this school is about 100 years old and has a rich

history of equality. Harmony Haven Institute¹ is noted for its firm stance on accepting learners of all capabilities, educating them in a mainstream space with the goal of differentiation as a technique of inclusion. This is guided by the rich history of the school which is rooted in anti-apartheid stances, where women and learners of colour were some of the first individuals to receive an education at this school during and after the apartheid era. This in itself enables differentiation simply because of the vision and mission that the school has used for decades and has passed down as the basis for its existence.

The school is a private school and, as a result, can afford teachers with wide-reaching opportunities to vary their lessons—with access to technology, equipment, and a vast number of resources. Being a private school enables teachers to fully immerse themselves in differentiation using a multitude of techniques each day. It is also important to note that this school primarily uses iPads as its form of communication. This affords learners the opportunity to not just be exposed to technology in classes, but to become proficient enough to begin relying on it as their space to document and complete work. Further, being allowed to use iPads provides access to a vast number of resources for teachers to plan their lessons, displaying how financial security can have a strong impact on a teacher's ability to differentiate.

4.3.2. Data Collection

The primary objective of this research was to thoroughly explore the intricacies of differentiation within the educational context. As such, seven teachers were interviewed as part of this qualitative research, with the explicit aim of conducting in-depth interviews with the research participants. All of these teachers teach one or more STEM subjects, which was the focus of this research. In this study, teachers were sampled using purposive sampling to ensure that I met the requirements aimed at focusing on – STEM teachers. Ultimately, a total of seven participants were selected based on their ability to provide rich insights into the research questions, ensuring a comprehensive understanding of differentiation. A summary of these teachers can be found in Figure 2.

¹ Harmony Haven Institute is a pseudonym used to protect the individuals present at this school, as was stipulated when applying for Ethics Clearance from the University of the Witwatersrand.

<u>TEACHER</u>	<u>SUBJECT</u>	<u>GRADES</u>
Zara	Life Sciences	10-12
Jordan	Mathematics, Mathematical Literacy, Mathematics Support	7-10
Adrian	Mathematics, Natural Sciences	4-6
Vince	Mathematics, Mathematical Literacy	9-12
Musa	Physical Sciences, Further Studies Physical Sciences	10-12
Thabo	Natural Sciences, Physical Sciences, Further Studies Physical Sciences	7-10
Fiona	Mathematics, Mathematical Literacy	9-12

Figure 2². The Seven Teachers involved in the Study.

Before beginning the process of data collection, each teacher was supplied with a participant information sheet and consent form. This consent form also informed the teachers of the topic they would be discussing with me, the researcher, as well as their rights as research participants. Questions were included on the consent form, delving into the grades, subjects and topics teachers would be teaching in the following term. This gave me an idea of the nature of the subject/s each teacher engages with, as knowing what topics and subjects teachers would be focusing on allowed me to understand the nature of their responsibilities and allowed me to prepare possible questions related to their subjects and topics to ask during the follow-up interview. This consent form was followed by a semi-structured interview that consisted of an observation of the differentiation that goes into lesson planning, where each teacher discussed their process of planning for a lesson without any prompts or questions by me. This was followed by questions on the teacher's choices in lesson planning, and a reflection on their process to discuss how and why teachers choose to differentiate their lesson plans this way.

The main form of data collection consisted of a semi-structured interview. This mode of interviewing was discussed in an article by Katsiaficas et al. (2011) who stated that “narrative methods provide simultaneously systematic and idiographic ways of understanding how a

² The teachers' names are all pseudonyms used to protect the participants of this research, as was stipulated when applying for Ethics Clearance.

person makes sense of the world around them and relates to and acts with others as a social being” (p. 122). Being a semi-structured interview meant that this interview could include multimodal techniques of ascertaining information differently to traditional interviews that are one-on-one in nature. By not asking teachers any predetermined questions or giving them any prompts, I gave them the freedom to discuss how they plan their lessons, unprompted or not led in any direction by me as a researcher. This is a critical realist practice, by which I discovered the ‘observed’ experiences of a teacher, viewing how they see their classrooms, ‘the worlds’, and how they react to and socially interact with the learners in their classroom spaces.

A) Observations

The semi-structured interview began with an observation of the lesson planning process a teacher goes through in preparation for all their lessons. During this, teachers were given the opportunity to either write down their lesson plans or orally discuss them. This process was entirely contextual, situated in each teacher’s classroom, with the teacher using the lesson planning technique with which they are most comfortable. Listening to teachers explain the process by which they planned their lessons gave me an insight into the thinking pattern a teacher experiences—how they make decisions, consider learners, rethink, and research a variety of methods of teaching. This provided me with an opportunity to witness the ‘observed’ structures that a teacher is aware of that have impacted their lesson planning, but also to interrogate the possible ‘real’ space that this information could have been learnt from, whether at universities, through experiences in schools, with learners, or in spaces outside of education institutions.

Collecting data in this manner gave each teacher the agency to plan according to their own experiences, exposure, and processes. During this process, my main function was noting down any observations and possible questions that helped determine why and how teachers reached the consensus that a pedagogical skill, strategy, or practice is vital in disseminating knowledge holistically in their classrooms. The advantages of this form of observations were numerous, spanning

1. An insight into the pedagogical strategies a teacher used to differentiate;
2. Understanding various differentiation practices;
3. Witnessing decision-making skills a teacher uses based on their experience with their learners to plan lessons;

4. Identification of factors that enable and constrain differentiation;
5. An understanding of the contextual experiences these teachers experience being a part of a private school, and/or as STEM teachers.

B) Interviews

Following the observation stage was the process of asking questions in an interview format with each of the seven STEM teachers. This served to ensure that the qualitative nature of the research could be upheld where each teacher was allowed to explain their thinking in an individualised setting. The questions themselves were not entirely predetermined due to the reliance on the teacher's lesson plan but were generally targeting (a) how they chose their teaching methods, (b) what experiences influenced their choices and (c) what previous experiences did not go as planned, and thus impacted their current choices of teaching. This gave me an understanding of how teachers structure their lessons around learners and the way they learn, as opposed to a general lesson plan that does not consider learners.

Interviewing STEM teachers was relevant to the context of my research, allowing me to gain a deeper understanding of how differentiation strategies vary and are similar across the various STEM subjects. Here, I had the opportunity to listen to how differentiation is tailored to meet the diverse needs of learners within a STEM environment specifically, situating my research into the very zone I intended—reflecting on the realities of STEM teachers and how they use differentiation. Further, it gave me an opportunity to witness if there are STEM-specific pedagogical practices STEM teachers use to differentiate their lessons.

From a social model approach point of view, this research allowed me to also include a focus on the diversity of learners and how teachers use innovative practices to address their needs in an inclusive manner. The aim of differentiation is to meet the requirements of multiple learners at the same time. As a result, this process of interviewing teachers allowed me to witness how they create a space that is not just imbued with learning, but also a safe space for learners to feel a sense of belonging.

4.4. Data Analysis – Margaret Archer's Social Realism: Morphogenesis

This entire research relied on considering the intersectional nature of teaching, and how teachers' experiences and exposures from multiple spaces and interactions affect their agency

when they plan their lessons to ensure differentiation. However, a large focus was on the ever-changing, dynamic nature of society and how it has a direct impact and influence on the way we, as teachers, teach. Therefore, I used Margaret Archer's ideas in social realism as a framework when analysing the data, as this theory focuses on social change and how structures themselves change over time, namely when it comes to three domains: (1) structure, (2) agency, and (3) culture. Archer developed this theory of morphogenesis to discuss the ever-transforming nature of social change, and how it changes over time, affecting and being affected by the individuals who are a part of its society.

Archer (1995) points out the following problem within the study of human beings,

The fundamental problem of linking human agency and social structure stalks through the history of sociological theory. Basically, it concerns how to develop an adequate theoretical account which deals simultaneously with men constituting society and the social formation of human agents. (p. 225)

Archer (2010) states that the development of her theory of Morphogenesis was because of the need to study the link between social structures and what they expect of us. Archer (2010) questions if we are even able to be agential in the first place if we are trying to fit into the mould of the social structure, which Archer terms 'structural conditioning'. This is an interesting insight into teaching, especially in the case of differentiation which does not expect us to rely on social models, frameworks, or structural norms to develop our lessons, but rather on our interactions with learners—those being the 'observable' factors that affect how teachers develop their lesson plans.

Whilst it is important to reflect on Archer's (2010) idea of the link between social structures and the individuals that are a part of it, a big portion of my research relied on the agency of teachers to attempt to differentiate, regardless of their experience with a variety of social structures. Here, it is important to note that, according to critical realists, structure precedes human agents. Simply put, human beings are part of an already existing structure. However, critical realists point out the importance of understanding that it is in fact the agents of these structures that have the ability to transform them through their agential actions. Knowing this was important to my study because it allowed me to understand that although differentiation can be constrained or enabled, it is the agency of teachers that open up the possibility of a transformation of the social structures.

Using this social realist framework, I was able to think more critically about the questions I

asked teachers; for example, the question, “Do you have an experience with teaching that has a lasting effect on how you differentiate your lessons?” With this question, teachers were able to unpack their experiences that have led them to think about differentiation in a different light, highlighting the very structures that cultivated them in the first place. Archer’s (1995) framework allowed me to notice the relationship between structure and agency, when a Mathematics teacher mentioned how his understanding of teaching from his university theory detailed a teacher lecturing for a portion of a lesson, displaying the involvement of structures like universities. His developing agency became more prominent when he admitted that learners did not understand that technique but rather benefitted once he began to involve them more in the teaching of the lesson.

Case (2015) explains how Archer’s (1995) theory takes a closer look at social change, change in social structure and the agency change that comes along with the dynamic nature of society. Case (2015) describes how this theory looks at the change in society over time, which greatly affects education, as noticeable by the change in the needs of learners. If new educational paradigms are to be created each time a change is noticed, then the societal beliefs and norms that are a part of that change are important in the study of any educational sphere. Archer (1995) theorises that a cycle is noticeable in the social experiences individuals have, displayed diagrammatically in Figure 3 below.

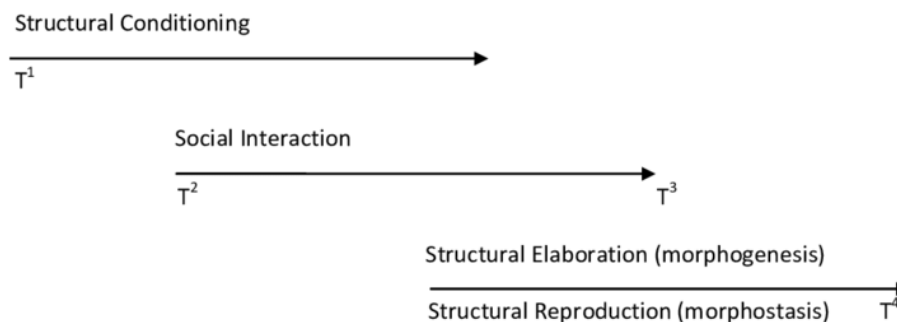


Figure 3 - Archer's (1995) Morphogenetic Cycle

In this cycle, Archer (1995) highlights four clear phases, each characterised by an experience. $T1$, she terms Structural Conditioning, a scenario in which structures exist and influence the individuals within them, constraining and enabling differentiation, in this case, in its own way but as the main impactor. Thereafter, Archer (1995) describes Social Interaction, a journey from $T2$ to $T3$, where structures become more established, with agential characters within this structure beginning to act either in favour of the norms and standards of the structure, or in opposition to them. Next, Archer (1995) develops this idea that with agency comes a

transformation, and suddenly within education there is a transformed structure, one which includes the changes of the agential actors within it. And suddenly, the morphogenetic cycle begins again, influencing the people which it is a part.

Archer's (1995) framework was imperative to my research, because it allowed me to situate and contextualise the results, noticing any influences from social structure, constraining, or enabling differentiation, agential actions of teachers, and a vision of what a T4 Structural Elaboration can look like now that teachers have begun operating in opposition to the structure that influences them.

Learners are the individuals who become a part of the structure and culture Archer (1995) speaks about, being altered by the mechanisms and norms which make up these structures and cultures. As a result, the agency cultivated in learners by teachers needs to be one where they can navigate real world spaces to be successful in their own way—a meeting point between structure, culture, and agency. This framework was necessary for my study because it allowed me to question whether teachers believe that differentiation cultivates a learner who can survive in the real world.

Elder-Vass (2007) describes the interlinked relationship between people and society, explaining it as if it is a cycle—people are influenced and influence society, and society is influenced and influences people. It is described almost as if people are congruent with society—society and its beliefs and norms survive and change because of the very people who make it up. This made Archer's morphogenesis useful to my study because there is a direct relationship between the societal experiences and lesson planning of a teacher; then how they choose to teach their learner is directly influenced by societal ideologies. Case (2015) states that,

Every person is born into a set of life collectivities, what Archer (2000) terms the 'conditioned "me"'. In the space of human 'interaction we note the development of corporate agency, the 'interactive "we"'. The full outcome of agential morphogenesis is the synthesis of personal identity and social identity into what Archer terms the 'elaborated "you"'. (p. 849)

Here, Case (2015) scaffolds why Archer's take on social realism was necessary for my research, explaining that teachers interact with our society, and then with others which in turn impacts and influences the way they see and interact with people depending on their position in relation to them within society. This is what a schooling environment entails as well. The

environment teachers create within their classrooms gives a learner an identity, they then interact with others based on their identity and begin to learn how, with agency, to interact with the rest of the world, through the classroom environment we create. This is why it is necessary to look at the societal interactions and experiences that have impacted a teacher because it is leading to the very environment, they are creating that has the potential to influence the future of each learner that is a part of it.

Archer's (1995) framework, in combination with critical realism, afforded me two main things: (1) the ability to witness the societal control structures and mechanisms have on teaching, and (2) the agential influence teachers have within their classrooms, that in efforts to change the structure, has an impact on their learners. Herein, I had the opportunity to witness how differentiation is constrained and enabled, with society impacting the quality of education of learners.

4.5. Trustworthiness

The reliability and validity of this research was aimed at including trustworthiness through the development of this research report. Through the use of semi-structured interviews, and a variety of research, I was able to engage with the participants in a manner that ensured the results in this report would be as valid and relevant as possible. According to Forerol et al. (2018), trustworthiness is established through credibility, dependability, confirmability, and transformability.

To ensure that the data collected was credible, I used semi-structured interviews which framed the introduction of the interviews as teachers' practices. Allowing teachers to begin the interview with a description of their lesson planning techniques meant that my questions on differentiation revolved around their personal pedagogical practices, and not on theory I had read about differentiation and was now aiming to witness. Through ensuring that there were no initial, predetermined questions that guided the interview in a particular direction, I attempted to make this research as credible as possible, reflecting the true experiences of the teachers in this study.

Dependability is guided by the ability to ensure clear research procedures and fair interview processes amongst all participants. This study being my third research endeavour meant that I have had prior experience with interviewing participants and documenting their experiences. Developing trustworthiness with the participants of this research ensured that I correctly

followed all procedures relevant to keeping them comfortable and safe, including a variety of information sheets, verbal and written consent, and the assurance that their names would be protected during the production and submission of this research report. The practices used from start to finish ensured that all participants were involved in the same type of interview process, their protection of the same quality, and the results reported in a credible manner.

To ensure that this research was confirmable means to, “extend the confidence that the results would be confirmed or corroborated by other researchers” (Forerol et al., 2018, p. 3). This practice ensures that the results produced in this research report were not one-sided. Due to the promises discussed and laid out in the consent form and ethical clearance process of keeping participants anonymous, my discussion of the results took place with my supervisor. Here, participant names were still not used. However, due to lengthy draft evaluation and in-person meetings, these results were unpacked extensively, with the research questions being answered as the driving guidance to ensure confirmability.

Lastly, transferability—the ability of these results to be used in different contexts. While the interviews revolved around teachers in a private school, what was interesting to note, and is discussed in the results section, is how the broader individuals and groups involved in the education system had a larger impact on teaching, compared to the financial security afforded by a private school. Teachers referred to contexts and practices highlighted in national policy documents and syllabi, the standardisation of teaching practices, and even ideas of learner agency and tertiary level teacher training. This research thus has the ability to be transferable because it has large sections which highlight the experiences of teachers under the same larger governing bodies in South African contexts, but also the historical idea of what it means to be a teacher.

4.6. Ethical Considerations

Throughout this research, teachers were protected as much as possible. Informed consent was gathered from participants verbally before the interviews, through signing of consent forms before the interview, verbally prior to the interview starting, and from the school before participants were even approached. Participants were informed about the purpose of the research through verbal communication and a physical participation information sheet, which highlighted their rights as a participant, including but not limited to participants being free to withdraw from the interview at any time. It is important to note that participation was entirely voluntary, and no monetary value was attached to this research.

Participants and the school were offered anonymity throughout this research report, with pseudonyms being used to protect the school and participants—no identifiable characteristics were used in this paper. Interview recordings can be found on a password protected device and will be destroyed once I receive a passing result for this research paper—this was communicated in the consent form given to participants.

This research paper received an Ethics Clearance from the Wits School of Education before the interviews took place, and was identified as a low-risk research, one which would not expect participants to discuss sensitive and triggering experiences.

4.7. Limitations

Whilst this research highlighted the factors that constrain and enable differentiation in a manner that I set out to achieve, it is important to highlight some of the limitations of this study. This includes: (1) sample size and contextual specificity, and (3) researcher positionality.

The sample size of this research included seven STEM teachers, due to it being brief in nature for this qualification. The act of differentiation is often described throughout this research as contextual and as such highlighting the contexts of seven teachers in a private school does not fully encompass the experiences of the masses of teachers teaching throughout South Africa. Further, it is important to acknowledge that private schools may have unique financial situations and histories that affect whether teachers may be able to apply these results to their experiences.

Whilst this research is specific to a particular context and detailed only seven teachers' experiences, the reflections on the factors that enable and constrain differentiation include structures that directly affect every teacher in South Africa, considering teachers are required to use the CAPS document. As a result, whilst there are limitations using a small sample size in a single private school, there is an overlap of teacher experiences as they all use the same syllabi to refer to when teaching.

Having a good standing with the school also impacted this study, as it demanded that I understand my positionality as a researcher with people who I knew before this research. It is possible that with teachers knowing my positionality on teaching, and my belief in differentiation, it may have influenced the findings if teachers did not fully discuss if they agree or disagree with differentiation. Whilst this is the case, beginning with an observation and not

motivating for my own opinion allowed teachers to engage with their own experiences first, positioning them in a manner that excluded me and my opinions from their lesson planning.

CHAPTER 5

RESULTS

5.1. Introduction

The outcome of this research is wide and far-reaching, encompassing a variety of structural, cultural, and agential flux in the educational space which create an interplay to produce certain outcomes. This flux itself is indicative of the dynamic nature of teaching, depending on teachers and those involved in educational institutions to reflect on the ever-changing needs of learners. As the years go by, new ideas and theories of education emerge, catering for the learners who change with the societies and spaces that they are a part of. The current era in South Africa embodies an overwhelming need for equality due to decades of colonialism and apartheid creating social divides and, as a result, differentiation came into play. With the increase in awareness about inequalities, structural and social, the need for differentiation arose from the idea that learners have a variety of learning needs, and education should change to accommodate these needs in mainstream spaces.

5.2. Flaws in Shaping Tomorrow: The Education System's Missteps in Harnessing STEM Potential

Archer's (1995) morphogenesis framework describes the institutions and organisations within our societies that disseminate their ideas which become normalised, part of a broader structure developed before these current individuals were a part of it. Archer (2010) discusses the idea that "structure logically predates the action(s) which transform it", introducing the idea that the structures that make up society act on individuals, influencing their initial conditions and interactions within spaces, but were developed before them, not by them. Social institutions such as the South African education system, and STEM as an institution itself, operate under the broad term of society, which happen to be the very frameworks under which human beings operate, and which have the unquestionable power to influence or impact the way human beings behave within society, or the way we think. While 'structure' does not determine individual actions holistically, it can have an impact on the way individuals begin to see the world as they are immersed as teachers in the parts of society that sustain this unchanging education system, displaying how intertwined structure and agency actually is. Structures can

be considered the ‘real’ described in critical realism, because of how they standardise a norm within spaces that often go unquestioned, invisible by nature.

In this case study, two extensive social institutions converged, :(1) the South African education system, which underlies all educational institutions, giving rise to schools, universities, and teachers, and (2) STEM, itself, as an institution, which has, historically, been built on the idea that STEM subjects have to be learnt in a particular manner. The information gathered from these case studies described how compulsory syllabi place time constraints on teachers, encourage standardisation, and create a divide between private and public schooling. It also described how university training requires a reshaping, to ensure that teachers acquire the skills they need to deal with mainstream classes, including learners with multiple learning needs at the same time.

One of the first things that you are expected to present during an interview at a prospective school when applying for a teaching position is proof of an education qualification. This qualification represents the fact that you must have existing prior knowledge in education that makes you an ideal candidate for the position. It is the ‘promise’ that you have completed matric at a high school and have then been adequately trained by a tertiary institution on what is teaching and how to teach. What many South African teachers have in common, is that they each come into contact with the South African education system, which is a social institution run with its own developed standards and ideologies.

The South African education system divides educational learning into two main bands: (1) the Basic Education system run by the Department of Basic Education [DBE] and (2) the Higher Education system., run by the Department of Higher Education and Training [DHET]. Primary school and high school fall under Basic Education and tertiary education falls under Higher Education—both of which are qualifications a teacher needs to teach. As a result, the South African education system plays a vital role in the life of a teacher, from the time they enter school as a young child, shaping the way they see education, as their qualifications are an unnegotiable requirement to become a teacher; therefore, making the South African education system’s pathway the only pathway for teachers. This institution therefore gives status to a teacher because the role of being a teacher means that you have successfully qualified from both basic education and tertiary institutions, with the standards being set for what is considered ‘qualified’ by these social institutions.

While the South African education system aims to represent the quality of the Constitution of the Republic of South Africa, being the leading structure that creates the syllabi which the country follows, means it inherits power, as one of the sole disseminators of what education looks like. Through the creation of these syllabi, the education system becomes the main societal influence on what knowledge is being taught, tested and how teachers are trained to teach. This standardisation of syllabi has a ripple effect, influencing the time a teacher has to teach, the assessments they use to test for understanding and furthering the divide between private and public schooling.

5.2.1. Time Constraints

The two groups that exist within the South African education system are the *Department of Basic Education* (DBE), which ensures the dissemination of the *CAPS Document* in most public schools, and the *Independent Examinations Board* (IEB) which ensures the dissemination of the *Subject Assessment Guidelines* (SAG) document in many private schools, and which is based on CAPS. The CAPS and SAG documents provide a layout of what needs to be learnt, what practicals are advised and what skills fall under each topic. These expectations are developed through the grades of a learner and lead to the final matric examination a learner writes, which is standardised. This gives many teachers no choice but to follow the SAG and CAPS documents, because they are preparing learners for a standardised test and, therefore, should be following the very standard suggested for them in the syllabi. This gives a lot of power to these documents, as they become the foundation upon which all lesson planning is developed, following the standards set by the South African education system. These syllabi stand as the ‘real’ factor described through critical realism, which is the often unquestioned, accepted, almost invisible power that a structure may hold. This has a constraining effect on differentiation which describes a lesson that may require a divergence from the timeframes stipulated in these syllabi documents.

All seven teachers within this case study referenced the SAG document or the CAPS document, with all of them stating that that is their point of reference to look at before planning a lesson. Some responses include using Bloom’s taxonomy to create higher- and lower-order questions during introductions that meet the standards of syllabi documents and using the CAPS document before finding resources because the resources found need to include the knowledge stipulated in the CAPS document. This standardisation of knowledge serves as the foundation of lesson planning for many teachers, as they attempt to meet the standards set out for them.

This poses a problem when attempting to use differentiation, because if differentiation is catering for diversity and the acknowledgment of diverse learner needs, standardisation—through the use of syllabi and final examinations—constrains differentiation entirely. Here, it is clearly shown that differentiation is being constrained by the need to standardise knowledge and cultivate the same type of learner—one who can write a final examination, the same as every other finishing learner, in order to gain the status of ‘passed matric’, with ‘failing matric’ closing doors to further studies and job opportunities.

This standardisation of education plays a role in constraining differentiation due to the structure it proposes, which includes a rigid timeframe on how long a teacher is expected to teach a particular topic. All seven teachers discussed the constraints of time, with many of them suggesting that differentiation cannot always be used within lessons because there is a list of topics they need to cover with a timeframe, so they often have an unchangeable number of lessons which they need to adhere to. As a result, STEM teachers believe that differentiation, in a manner that addresses all learners’ needs, is constrained by the syllabi because there is no time to allow them to engage with learners further if there are misunderstandings, or misconceptions. When asked about what challenges a STEM teacher may face, Vince responded with the following,

...There are times where time constraints I think, don't allow you to, to maximise or, you know, implement some of the things that you think, “I want to try this with differentiated learning” or, you know, “That was a really good idea. I want to try it.” But sometimes you don't actually have the time to do it, sometimes it's also ok.

Differentiation involves trial and error, where teachers test various teaching techniques to meet the diverse needs of learners. In STEM subjects, this includes addressing misconceptions and connecting abstract concepts to real-world applications. However, rigid syllabi often limit teachers' ability to fully implement differentiation due to time constraints. This creates inequalities, as some learners may struggle to succeed within these time constraints. Unfortunately, time laid out by the syllabi constrains teachers from truly immersing learners in the real-world applications through differentiation, because there is a finite number of lessons dedicated to a topic that will disallow them from trying out the variety of practices differentiation entails. These documents, without stipulating it, have power over teachers who feel the need to move to the next topic to avoid missing what might be vital information for a learner’s future in their subject. Thus, further inequalities are created, where learners are

divided into those that are able to handle the demands of the syllabi, versus learners whose needs cannot be met due to time constraints, and who then become labelled as learners who do not succeed. This raises questions about the continued use of standardised syllabi and exams in future education.

Differentiation involves trial and error, where teachers test various teaching techniques to meet the diverse needs of learners. In STEM subjects, this includes addressing misconceptions and connecting abstract concepts to real-world applications. However, rigid syllabi often limit teachers' ability to fully implement differentiation due to time constraints. This creates inequalities, as some students may struggle to succeed within these constraints, with them being isolated from those who can succeed during those timeframes. This raises questions about the role of standardised syllabi and exams in future education – if standardisation has such a dire constraint on differentiation, I question whether or not these standard syllabi and examinations even have a place in education in the future.

5.2.2. Standardised Assessments

In the expansive space of STEM education, teachers face a unique challenge – they are tasked with imparting knowledge that spans various professions, from spacecraft design to vaccine creation, preparing learners for diverse career paths, all while also preparing learners to pass a standardised final examination first, to pursue those careers. This creates a paradox: while differentiation is necessary to accommodate individual learner needs, standardised assessments limit this flexibility by expecting learners to all meet the standards set out in syllabi. In South Africa, where learners come from diverse backgrounds, embracing these differences is essential, however, standardised assessments constrain differentiation by requiring conformity when measuring success in final examinations.

Detailed in the CAPS and SAG documents are lists of topics and skills a learner needs to develop and acquire, enabling them to pass the final examination at the end of their schooling career. Through following the topics and skills listed in the education system's syllabi, teachers try to cultivate an 'ideal' learner which, according to this system, is one that can learn the syllabi topics, and use that knowledge to answer a final examination to achieve their qualification. This constrains differentiation, because while it may allow teachers to invite prior knowledge and experiences in their lessons, their lessons should always aim to teach learners what they need to know for one final examination. This poses the question of how can educational institutions expect learners to thrive post-education years, where they are expected

to fill different roles within society, but are taught to be one type of learner, with fixed knowledge, skills, and expectations to meet in schools? How are learners expected to have the agency to use STEM in a way that aligns with their interests, when they are being constrained by a syllabi that requires them, all diverse individuals, to write standardised assessments?

The standardisation of assessments largely constrains differentiation in STEM subjects which, in turn, is counterproductive for the real-world experiences of STEM. All seven teachers addressed the worry that they have about differentiating, if it means that they stray too far away from what a learner needs to know for their examination. However, STEM in the real world rarely requires individuals to write an examination without any resources. In fact, STEM requires you to work through a variety of resources to achieve a goal—whether that means you use resources to build a rocket or a bridge, or you write a textbook on statistics. STEM, while abstract in nature at schools, is entirely practical in nature for learners who pursue it after school as a career. This poses the question: Should we eliminate standardised examinations as a form of testing to see if learners receive a qualification? Here, to enable differentiation may mean to engage with developing final assessments that reflect the interests of learners, posing a unique challenge to education systems which have been built upon standardisation.

Differentiation is constrained by the pressurised action being placed on teachers to prepare learners to write a standardised assessment to display their capabilities and skills. All seven teachers reflected on the pressure of this, and how it causes them to avoid fully differentiated teaching, because of the worry of them allowing learners to move too far away from what will be expected of them. Musa summarises it, questioning. “So as much as we are differentiating, at the end of it all, they are writing the exact same exam, but my question is then, do exam results help you differentiate?”. The question is a concern, because it directly displays how differentiation is constrained by the idea that a successful learner is one that can achieve in a single, final examination period. Musa brings up a powerful question – are assessments going to help you differentiate lessons? If so, does this mean teachers are required to use assessments to differentiate, with the sole purpose of aligning them back on track to passing the next standardised assessment? The power that the DBE holds when designing these final examinations further divides learners within our systems, constraining differentiation, which is reflective of the difference in experience on private and public schools.

5.2.3. Private vs. Public Schooling

Set in the eastern suburbs of Johannesburg is Harmony Haven Institute, the private school on which my case study was based. Hailing from a rich history of fighting inequalities, this school is renowned for its mainstream classes which include learners of a variety of learning needs. This places the responsibility on teachers to address these learning needs in an inclusive manner, including a variety of teaching tactics and differentiated lesson plans. This school's mandate includes a compulsory implementation of differentiation, supported by management and the school board. Being a private school enables differentiation, through the use of the CAPS and SAG documents since they (1) can aim to have small class sizes, and (2) have the funds to enable the use of differentiation.

The CAPS and the SAG documents are not entirely constraining. Set out in a detailed manner, they include topics which attempt to prepare learners for their future careers, skills they need to cultivate and further knowledge necessary to apply their theory in the real world. Evidence of this can be found in Figure 4, below, which details the topics and skills a learner is required to be exposed to in order to fully understand cells in tissues, organs and systems, an abstract topic in Natural Sciences, considering the microscopic nature of said cells and tissues.

TOPIC	CONTENT & CONCEPTS	SUGGESTED ACTIVITIES: INVESTIGATIONS, PRACTICAL WORK, AND DEMONSTRATIONS	EQUIPMENT AND RESOURCES
Cells as the basic units of life <i>[continued...]</i>	Cells in tissues, organs and systems <ul style="list-style-type: none"> • cells come in many different shapes and sizes • cells are adapted to perform specific functions, such as muscle cells which are specialised to contract and enable movement • microscopic organisms such as bacteria, consist of a single cell. Macroscopic organisms such as humans, consist of large numbers of cells • a group of cells performing a specific function form a tissue, a group of tissues make up an organ, and organs working together in groups form systems, systems make up an organism • stem cells are cells that have the ability to divide and develop into many different cell types <i>[No detail required]</i> 	<ul style="list-style-type: none"> • researching and writing about the history of the discovery of the light and electron microscopes • tabulating functions of the different parts of a basic light microscope • preparing and examining slides of plant and animal cells such as onion cells, cheek cells. Draw and label a few cells from each observation <p style="text-align: center;">AND/OR</p> <ul style="list-style-type: none"> • examining micrographs of plant and animal cells. Draw and label cells from at least two different tissue types • researching, discussing and writing about stem cell research and ethical issues involved 	<ul style="list-style-type: none"> • micrographs of plant and animal cells

Figure 4 – Excerpt from the CAPS Document, 1996, pp. 57

The CAPS document presents a holistic understanding of the topic on *Cells and Tissues*, highlighting the most important things a learner needs to know, giving them the opportunity to work with a microscope, and identify parts of a plant using a microscope. This means that at the end of their schooling career, learners at Harmony Haven Institute who can follow through with the requirements of the CAPS document are learners that are fully equipped to begin learning further on how this is applied to real-world situations dealing with microscopic

phenomena. Through adding these skills to supplement topics, these syllabi enable differentiation.

Further, within this case study, three teachers referred to small class sizes enablement of differentiation. Each of them agreed that having less learners within their private school classrooms allowed them to engage with learners in a variety of ways. Jordan described an inventive approach to teaching complex questions using sticky notes. She described it as follows:

At the end of the lesson, I will give them one question on the board that they have to do individually on their sticky notes. Naturally, it is something that they can be excited about, it is something different, not something that they are doing in their books. And they can throw it away once they have finished. It does not mean anything besides whether you can do it or not.

Here, Jordan describes a situation where she hands out sticky notes and allows learners to engage with a complex question. She then moves around checking if learners are getting it correct, allowing learners who have gotten it correct to describe their process to those who are struggling—all with the incentive that they receive feedback in a manner that will not make them feel despondent the way a formal test would if they receive a wrong answer. This type of differentiation is enabled in private schools who have classes with a smaller group of learners, in this case any class size below 32 learners. Differentiation is enabling in a private school space which has access to resources and technology, and class sizes, which is a celebration of diversity within Harmony Haven Institute, where learners each receive the feedback, they need to grow, time with their teacher and resources to explore STEM more.

Unfortunately, differentiation may look different in public schools that cannot afford the technological resources and small class sizes a private school may have. In a study by De Jager (2017), secondary school teachers claimed that in public schools there is a lack of resources and large class sizes which constrain teaching. De Jager (2017) states that,

Insufficient basic resources such as toilets and electricity not only contribute to an unhealthy learning environment but also weaken learning and teaching in a school. In addition, insufficient teaching resources could prevent interactive participation in the curriculum activities, as extra support materials are needed (Badat & Sayed, 2014; Chisholm et al., 2005). (p. 119)

Here, we view how the South African education system fails to allow differentiation to happen, furthering the divide between private and public schools through the socioeconomic and sociopolitical influences on learning. Learners cannot be exposed to differentiation because the syllabi documents, which theorise what an ideal learner needs to look like, cannot be achieved because of the lack of resources, finances, and small class sizes. As a result, differentiation is constrained by the societal divides within schools, because how can we teach a learner how to use microscopes, if none are present, or if few are present in a class of 50 learners? This calls for a different version of the syllabi that either accommodates differences in finances or demands that the schools which are expected to implement these practices be better equipped to do so. Here, we notice how there is an interplay between structure and agency, where institutes determine the ideal dissemination of knowledge, but teachers involved in said institutions interact with learners and develop the agency to question structures when the syllabi cannot be used to ultimately meet the needs of their learners.

Private schools enable differentiation through their access to resources, financial security, and smaller class sizes and, as a result, we witness how teachers can aim at working towards a classroom where their learner needs are addressed. Unfortunately, this is not always the case in South Africa. Thus, it poses a challenge for those attempting to create differentiation strategies because of the divide caused by access between private and public schooling and calls for a more open look into the social status gained by not being in a private school, and the unfairness further developed within the education system which is assumedly reaching for equality.

5.3. Empowerment in Action: Embracing Agency for Divergent Paths

As has been noted previously, Harmony Haven Institute is a private school which boasts an influential history with equality. This school is renowned for taking in learners with varying learning needs, but also for having taken in learners of colour and females during apartheid, a phenomenon not many schools can boast about. At its foundation exists a variety of alumni, board members and teachers who have, historically, been part of creating a school which can embrace and actively enable a new theory such as differentiation. Archer (1995) details a morphogenetic cycle, one which starts with an existing structure which has power and influence (T1), and a second, and third part of the cycle (T2 → T3) which, through social interaction, displays how agency allows for the divergence from anything which constraints

the interests or growth of the institutions which fall under the structure. In this case, T2 → T3 addresses how agency impacts differentiation within Harmony Haven Institute.

5.3.1. Reimagining Teacher Training

5.3.1.1. Teacher Training

When teachers enter their first teaching position, they bring with them a qualification from a tertiary institution which shows that they have some sort of teacher training needed within schools. Tertiary institutions such as universities and colleges follow policies set out by the governing body of South Africa, including but not limited to *White Paper 6* (DoE, 2001) and *The Policy on Screening, Identification, Assessment and Support (SIAS)* (DBE, 2014). These documents encourage differentiation, seeing learners as individuals because each of them is based on the Constitution of South Africa, which I have understood, works towards equality. *White Paper 6* (DoE, 2001, p. 16) clearly states,

In this White Paper inclusive education and training:

- Are about acknowledging that all children and youth can learn and that all children and youth need support.
- Are accepting and respecting the fact that all learners are different in some way and have different learning needs which are equally valued and an ordinary part of our human experience.
- Are about enabling education structures, systems and learning methodologies to meet the needs of all learners.

Based on these documents, striving for equality is the teacher training that tertiary institutions are required to follow. As a result, these institutions have the responsibility of not just teaching about the theory behind education, but also equipping future teachers with the skill of being able to acknowledge difference and enable learning regardless of difference. Unfortunately, as evidenced by the results of this case study, this is not always achieved, with many of these teachers relying on professional development during their formal teaching experience, after leaving a tertiary institution, to learn how to differentiate.

The seven participants in this study had varying levels of teaching experience, ranging from 1 to 12 years. Interestingly, all of them stated that their practical knowledge of differentiation came from their teaching experiences rather than their tertiary education. For instance, Musa and Thabo mentioned they did not learn about differentiation in their tertiary institutions at all. This highlights a constraint on differentiation, as teachers are expected to discover and make

use of it after becoming qualified. A challenge that is addressed by teachers learning how to differentiate during their formal experiences is for tertiary institutions to better equip teachers for the demands of national syllabi. It is essential for individuals within these institutions to recognise the need for change and actively work towards adapting pedagogical frameworks to meet evolving societal and learner needs. This requires questioning institutional ideologies and cultivating agency among teachers to address growing and progressing diversity effectively.

Six of the interviewed teachers struggled to identify any practical elements from their tertiary education that aided them in differentiation. Instead, they relied on trial and error in the classroom to address student comprehension issues. However, one teacher, Adrian, learned about differentiation theory at his university but only gained practical experience during student teaching. He found that traditional lecture-style teaching, practiced at his tertiary institution, was not suitable for STEM subjects. He explained how this form of teachers lecturing is not ideal for STEM, where learners benefit more from practical collaborative lessons, as opposed to sitting idly and listening to practical applications. While it's reasonable for tertiary institutions to structure practice lessons for larger groups of student teachers, aimed at building confidence in presenting to classrooms, it raises questions about the practical relevance. How does speaking to large groups, without interaction with the audience, at university prepare teachers for the reality of engaging with smaller, more diverse groups of learners in their future classrooms?

Due to the lack of practice in differentiation during teacher training, teachers struggled with incorporating differentiation into their classrooms at first. Teachers feared that using brand new techniques for the first time on learners could result in negative consequences if it did not work, losing valuable time. This could have all been alleviated if teachers had been given the opportunity to practise differentiation at tertiary institutions, where the consequences of not getting it correct would result in constructive feedback, and not learners failing. Here, we notice how the South African education system can still constrain differentiation, because a teacher is required to achieve a qualification from the institutions that fall under this social institution, but they are not prepared enough to know how to address different learning needs, causing them to either avoid it, or fear it.

A Mathematics teacher, Jordan, mentioned that "It is all well and good to learn how to differentiate a lesson, but it is not good if you do not know why you need to differentiate your lessons." Jordan went on to explain that she discovered a variety of different learning needs

and barriers within her teaching experience, for example, dyscalculia, which she explains as a difficulty in understanding number-based information. An article by Haberstroh and Schulte-Körne (2019), claims that “Three to seven percent of all children, adolescents, and adults suffer from dyscalculia” (p. 107). In a country with millions of learners such as South Africa, it can be assumed that there are learners in many of our schools with dyscalculia who require differentiation to fully understand any numbers-based information. However, if a teacher is not trained on the possibility of these learning barriers, teachers go into classrooms not understanding at first why they even need to differentiate. None of these teachers disparage their tertiary institutions, as do they believe that not every learning barrier and need can be addressed during one qualification, however, they believe that more time needs to be allocated to the practical aspects of teaching, so that even if they walk into schools not knowing how to differentiate, they are still aware of why they need to differentiate, and what they need to look out for. This is an example of how, within social institutions, there are individuals with agency whose experiences impact their ability to question their institutions and the broader social structure.

Tertiary institutions, as the structural foundation of all teachers, need to incorporate more practise into differentiation because not knowing why or how to differentiate constrains learning. Teacher training in educational institutions cannot exemplify a manner of teaching that is not realistic for teachers who will teach in diverse South African contexts, and this constrains inclusive education practices like differentiation. However, schools, as structures of institutions, need to motivate teachers who wish to or need to develop professionally; this helps them immensely when they know that schools are supportive. This brings us to our next structure—the school as an environment which embraces professional development and upskilling.

5.3.1.2. Professional Development

One of the practices that is encouraged at Harmony Haven Institute is that of professional development, in order to upskill teachers as new learner needs arise. Professional development is an ongoing conversation across all educational institutions—the action of constantly upskilling teachers to meet the needs of their learners. Teachers at this school, as part of professional development, are encouraged to develop their skills and knowledge, and motivated to take extra courses to ensure that they can differentiate once the need arises. Professional development and the support of management for its widespread reach to all teachers has the

potential to create an agency in teachers which enables differentiation. This develops a different working relationship concerning the interplay of structure and culture, because rather than being controlled by institutions governed by a societal structure, teachers, with agency, work to improve the institutions according to the current learning needs – displaying how this interplay should not be rigid, but rather, dynamic.

Harmony Haven Institute responds to teachers feeling underprepared for differentiation by offering professional development opportunities and a collaborative learning environment. As part of their ongoing development, teachers who volunteered were introduced to Rhonda Bondie's (2018) book, "Differentiated Instruction Made Practical," through an online course led by Harvard lecturer Rhonda Bondie. Teachers who participated subsequently became 'leading teachers,' guiding discussions on differentiation for their colleagues who could not attend. This approach ensures that differentiation is introduced uniformly, allowing teachers with a space to unpack differentiation and share challenges, successes, and strategies specific to their shared context. By providing knowledge, spaces for collaboration, and skills development, the institute empowers teachers to employ a variety of techniques in their teaching practice, regardless of teachers begin governed by standardised syllabi and the upcoming final examinations learners are expected to pass. This displays how, within social institutions, through experiences, agency is developed to begin questioning the very social institutions of which teachers are a part.

Tertiary institutions, as the foundation of all teachers, need to incorporate more practice into differentiation because not knowing why or how to differentiate constrains learning. Teacher training in educational institutions cannot exemplify a manner of teaching that is not realistic for teachers who will teach in a diverse space, as this constrains inclusive education practices like differentiation. However, schools as social institutions need to motivate teachers who wish to or need to develop professionally. This helps teachers immensely when they know that they are supported—which brings us to our next point—the school as a supportive environment.

5.4. Empowering Teachers: The Crucial Call for Support within Schools

Archer (1995) discusses the idea that agency and action can facilitate the elimination of societal influences that constrain useful ways of teaching. She infers that social groups may fall under a social institution such as the South African education system and be influenced by it, but their

actions cannot be holistically controlled because they have the individual agency to decide how to act. As a result, what enables differentiation is a supportive school, because it allows teachers to move away from the influence of the structure to a space where they can attempt differentiation, even if they were not fully equipped to acknowledge or deal with it in their tertiary institution.

What was glaringly obvious amongst all teachers in this interview was the importance of the school environment being a supportive space. All seven of these teachers described the perfect environment for differentiation as being one where they are supported by the management and mandate of the school. According to these research participants, differentiation needs to be a value of the school stipulated to all individuals who are involved in the caring of the learners—from teachers to guardians. Here, it is discussed that a factor that enables differentiation is a school that has a culture which disseminates ideas of differentiation throughout all levels—from marketing the school to prospective learners as a school that addresses differentiation, to supporting new and old teachers who are expected to differentiate their lessons. It is important to note that differentiation is not the only approach to teaching, as learners and teachers may find approaches that work best for their class. However, supportive schooling environments make learners and parents aware of the educational ideology of the school, so that they understand that there will be a combination of instructional strategies to address any diverse needs of learners within the school's policy.

The benefit of having a school-wide understanding of the approaches to teaching that schools use is that it becomes simpler for practices to be implemented, as highlighted by Harmony Haven Institute which has differentiation at its core throughout all conversations with learners, parents, and guardians. A Life Sciences teacher, Zara, explained that differentiation can come with a variety of activities such as (a) Think-Pair-Share, an activity where learners are given time to think as individuals, share with a partner and then discuss as a class; (b) an entry ticket, which is an activity done at the beginning of a lesson to gauge prior knowledge; and (c) an exit ticket, which is the completion of required work to assess understanding before learners leave. Zara explained that when she enters a classroom, if learners are not used to or were not introduced to teaching where a variety of tasks are included, but instead are used to being lectured by their teachers, they will struggle to understand why it is necessary to perform these differentiated tasks. She explained that we cannot expect learners to only have differentiated lessons in one class because,

The child will feel very overwhelmed because it is not a system that they are used to. But in the case where, if they walk into a school and they are expecting that teachers are very skilled, the students already know that is an expectation, so they easily carry that in. When it is not an expectation, the students will say no, they will feel like it's the teacher's responsibility to teach them, because every single lesson it has been the teacher's responsibility to teach them.

Here, we understand that while teachers understand the importance of using syllabi to teach learners, the main way they plan their lessons is not always based on stipulated syllabi, but rather on the comfort levels and learning needs of their learners. A supportive environment does not just develop on teacher agency to try new pedagogical ideas of thinking, it also allows learners to begin taking ownership of their own learning. Once learners take ownership of their learning, differentiation is enabled because it allows teachers to try a variety of differentiated tasks, and learners will be open to these tasks, and not feel the need to learn passively. Here, we witness how agency gives rise to agency—while teachers are constrained by the syllabi they are expected to teach, the way they make sure learners access this knowledge is their developed agency, and through doing so, they encourage learner agency. If the development of 'agency' allows learners to learn in a variety of ways and understand that it is not wrong, we allow future leaders and individuals within society to question the rigid frameworks like education systems.

A supportive environment encourages teachers not to work in isolation from each other. Differentiation, while an extremely useful technique to address learning differences, can be challenging considering the number of differences that need to be addressed. Teachers become overwhelmed when they are struggling with differentiation, and often shy away from it. However, Harmony Haven Institute dedicates time for teachers to share their best practices and their struggles with differentiation. Here, teachers can discuss their techniques of differentiation, after having learnt these during professional development. This enables differentiation because it encourages upward learning, where teachers strive to improve their teaching without feeling judged. A supportive school structure enables differentiation through encouraging teachers to share challenges and best practices. This helps struggling teachers receive assistance rather than feeling isolated. Professional development, as Musa noted, boosts confidence in continuing differentiation, while Vince learned the value of personalised feedback through activities like the Sticky Note exercise. Thabo highlighted how differentiation in formative assessments, such as gamifying them, reduces learner stress.

Each of these teachers sounded enthusiastic when explaining how differentiation worked as they developed it through sharing practices and struggles. Teachers become enthusiastic about differentiation, with them feeling confident enough to try out new techniques to enable differentiation if they are in an environment with likeminded individuals willing to empower them. Supportive spaces enable differentiation, developing an agency which questions the rigid framework of educational institutions, progressing the interplay between structure and agency from rigid and unchanging, to dynamic and learner centred.

5.5. Empowered Teachers: Navigating Differentiation with Agency

Archer's (1995) theory, to reiterate, states that while 'structure' does not determine individual actions holistically, it can have an impact on the way individuals begin to see the world as they are immersed as teachers in the very structures that sustain this unchanging education system. The options Archer (1995) provides here are that of teachers who stick to the status quo of a social institution—this being South Africa's education system—versus teachers who have the agency to begin acting towards differentiation regardless of the constraints. These teachers who act beyond constraints are the ones who socially interact with and unpack learner needs, ultimately enabling differentiation because they feel empowered enough to navigate differentiation. This process begins with student-teacher relationships, and how they display learner needs.

5.5.1. Building Bridges between Student and Teacher

So far, I have been discussing the constraints and enablement of differentiation through the eyes of larger institutions and the agencies of individuals. Here, however, I believe that it is important to reflect on the learner, and how teachers engage with their learners to enable differentiation. Differentiation is a process, more than simply a teaching technique, it is a way teachers develop a relationship with their learners, understanding who they are, learning what they need and then acting on that in further lessons. The culture of teaching needs to change, where learners are not objective individuals that need to be taught, but rather subjective individuals with interests, hobbies and learning needs that need to be met, and in order to know how to teach them, teachers need to know them as individuals and not just as authority figures handing out knowledge.

One of the cultural norms that has been quite prominent in education is that of a student-teacher relationship being based on only the dissemination of knowledge, in the way a teacher prefers.

Teachers base their lessons on content knowledge and learners learn from them – it is usually only the learners who are struggling that are called in and supported through the misunderstandings and misconceptions. This technique does not always develop a working relationship that successfully ensures that differentiation takes place, because differentiation entails making knowledge relevant to learners, which requires you to know your learners beyond their test results. Teaching has this norm where the teacher is a person of authority and learners need to be the listeners and passive learners, but this constrains teaching. How do we hear what learners need if their voices are not prioritised?

A Mathematics teacher, Adrian, discussed his own experiences when responding to the idea of student-teacher relationships. He explained,

When I was in school, I feel like a lot of the teachers didn't really worry about your relationship that you had with your learners. They sort of just came to school, opened the textbook, gave you work, explained the work, homework. It was that cycle that was boring. You wake up on a Tuesday, and feel, “Urg, it’s school again.” But the moment you as a teacher change that, and get involved with your students, and build a relationship with your students, that changes everything—how they are in class, how they are to you, how they understand the work. I mean, it is the simple fact that changes the relationship.

Schools offer learners a routine, a timetable that does not change the entire year. Adrian explained that if teachers have the authority and learners do not have their voices heard, a monotony is created where learners feel like they are doing the same thing repeatedly, nurturing a listlessness that makes teaching extremely challenging, constraining differentiation entirely. However, Adrian noted that the more teachers begin to close that gap between learner and teacher, the more they begin to listen to their learners and identify what they need, developing a relationship that reflects more on dynamic agency and not rigid routine following. This displays how teachers can act differently to what their social institution expects of them.

What was echoed by many teachers during different points of this research was that STEM subjects are often abstract in nature. STEM teachers teach learners about phenomena that are not always visible, such as atoms, cells, and speed, amongst others and, as a result, learners may struggle to be able to understand the information and be able to apply it to brand-new situations. This can harm the confidence of the learners who do not understand, and it is imperative to avoid singling them out, as this acts in opposition to inclusive education.

Differentiating lessons needs to work against isolating learners who do not understand, and teachers were asked to reflect on how they avoid this. A Mathematics teacher, Vince, expressed the following when asked how he teaches ensuring learners are not excluded:

I think the initial thing is to try and know each of the learners as best as you can know, know what excites them, what their passions are, what their interests are. And hopefully within that you can find some common ground that you can use or things that you can use to try and motivate them, because not all of them are going to be self-motivated.

While making lessons relatable was the initial step to lesson planning, knowing learners enough to understand what is relatable is the first step. Learners who find STEM subjects abstract may not understand using one technique, and instead of isolating these learners as ones who cannot do STEM subjects, it is important to engage with what interests them, because the culture of excluding learners because they do not understand is unfair to them. How teachers can reach learners is by changing the way they see themselves as authority figures as teachers. Teachers need to instead attempt to show learners the work in a different way, in the hopes of reaching more of them. The norm of teachers as authority figures constrains differentiation and learning, and teachers need to unpack this ideology of learners as a social group being passive individuals, and teachers as authoritative figures, with the sole responsibility of throwing knowledge at learners. Learning needs to be an active, dynamic process in order to enable differentiation.

Building relationships with learners can assist teachers struggling with differentiation in new environments as well, even if they are not new teachers. Zara, an experienced teacher, was new to Harmony Haven Institute. She learned that her previous teaching methods did not suit all learners. By prioritising learner feedback over her own assumptions, she improved her ability to differentiate. This approach empowered learners to voice their needs, leading to more effective teaching and shared ownership of learning, fostering an active learning process where learners take ownership of their education. In this way, teachers collaborate with learners, dismantling traditional power dynamics and cultivating an inclusive classroom where every voice is valued equally.

To summarise this section and introduce a new one, Zara succinctly described the student-teacher relationship as follows:

Once they gain their confidence it increases and boosts their self-esteem. And once their self-esteem is boosted, they are able to tackle whatever problems they can have beyond

the class, because I think everything boils down to how do they look at themselves? Do they look down on themselves, or do they value themselves? So, once you assure them that “No, you are fine, you are going to survive.” Then they say, “Ok, this I can get,” then they will be able to survive in the real world.

By knowing learners, and constantly working on knowing them, working on differentiating to accommodate the way they need to learn, teachers give them the feeling of being noticed, and that gives them the agency and, importantly, the courage to always try, even when the subjects become abstract and challenging. This is what needs to change in teaching, the idea that teachers are not anything beyond providers of knowledge or authoritarian knowledge keepers. Teachers are self-confidence cultivators and boosters, and creators of motivated individuals through differentiating. This introduces a new form of teaching and active learning, one that has the power to exist within the current structure, but also begins to change this structure, giving way to a new way of teaching and learning using differentiation.

5.6. Learner-led Learning: Pioneering a Paradigm Shift in Education

Thus far, I have engaged with multiple instances and examples of what constrains and what enables differentiation, a daunting, but effective practice in education. In this subchapter, I will illustrate an example of what a future with differentiation can look like, through the practices of the participants of this study. Archer (1995) defines this as ‘structural elaboration’, the end of a structural condition, with a host of new social possibilities which in itself will serve the future teachers in both a constraining and enabling manner, depending on their conditions. This chapter will serve as a stepping point from which further research can be done, to elaborate on how differentiation can enable new possibilities for teachers in South Africa, ending and beginning a new morphogenetic cycle.

5.6.1. Rethinking Lesson Plans

Teachers in training are often expected to become familiar with a structured lesson plan template. In fact, many tertiary institutions expect teachers in training to produce multiple lesson ideas embedded in a rigid template of a lesson plan. As a result, teachers begin to believe that a lesson needs to be rigid and structured, including a variety of support resources but still following the same pattern. Learners are once more placed in a routine, where their lessons are always structured, repetitive and unchanging—even unquestionably so. Once they get used to a certain way of teaching, introducing differentiation which is often structured differently for

each lesson can appear daunting to learners. This does not bode well for lesson plan templates which constrain differentiation.

My research set out to witness how teachers plan their lessons, with my proposal suggesting that I start my interviews with a teacher walking me through the process as they write down their differentiated lesson plans. To my surprise, all seven teachers stated that they do not use the lesson plan templates that they were required to formally study and use within their tertiary institutions. As a result, they could not write down a lesson plan and my first intention for my interviews was replaced by verbal explanations of how teachers went about planning their lessons. This highlights another change to tertiary level education, where the power held by making lesson plan templates compulsory to all teachers in training needs to be revised to reflect the lesson planning needs of the teachers, based on their experiences with their learners. Rigid frameworks may guide teachers to what they need to look for, but they need to be open to change and alterations when called for.

De Jager et al. (2017) carried out a study on secondary school teacher quality based on poor learner performance in South Africa. De Jager et al. (2017) reported the following dire conclusion,

The findings coincide with those of previous studies which indicate that teachers are not always willing and/or able to adjust their teaching methods to curriculum changes (Ercan 2012); are not adequately trained in how to create differentiated activities (Vandeyar and Killen 2007); do not always show positive behaviour in class (Ramsey 2000); are still using teacher-centred methods (Lekgoathi 2010), are unable to create a positive learning atmosphere (Cohen et al. 2009), and might not be motivated enough to encourage students to achieve successful learning outcomes (Anderson 2007). (p. 420)

This conclusion from their study paints a picture of teaching that constrains differentiation entirely, with classrooms filled with teachers who are not open to any change. Teachers who are as rigid as the social institution laws that they fall under constrain differentiation in an unquestionable way, cultivating lessons that place them as authority figures. This is reflective in the overreliance on lesson plans that tertiary institutions hold on to. Tertiary institutions led by the South African education system have monopolised the expectation of what it means to plan lessons, expecting teachers in training to follow templates that prepare teachers to be one

type of teacher. This power constrains differentiation because it does not adequately prepare teachers for the reality of teaching in a diverse South Africa.

It is not to say that teachers are no longer planning lessons in any way—in fact, all seven of these teachers do plan, they just do so according to the needs of the learners, and not a rigid structure and timeframe. Some teachers begin their lessons with a discussion, others allow learners to watch a video and engage with their prior knowledge. Some teachers start their lessons by revising previous content, others like Zara, ask learners a question like, “If aliens came to South Africa, how would you describe what a plant is to them?” Zara explained that when learners respond with “Plants are green,” she counters by stating that, “Some clothing is green, so what happens if an alien thinks that some clothing is also plants?” She continues to question their simple answers, with comments like, “Oh, plants are living, but so are animals and that will confuse aliens.” She noted that learners were a lot keener to discuss this very ‘out of the box’, unusual way of teaching because they were eager and could relate to the topic, which was asking the same required question, “What is a plant?” This is valuable to know because learners were also taught critical thinking skills and were allowed to display any gaps in their understanding which could be corrected before moving to the rest of the lesson. Musa, Thabo, and Zara stated that some lessons do not go to plan, so they have to switch to accommodate the learners, even if they are disappointed that their planned lessons do not get used. Rigid lesson plans are outdated, and they constrain differentiation entirely.

Rigid, structured lessons themselves as a norm is changing, and these teachers reflected on them. They discussed ideas of assessing understanding through building projects, using gamified versions of quizzes when learners are not engaging with formal textbook activities, and asking learners to produce a more effective way of remembering the work. One effective idea that caught my attention as a Life Sciences teacher, was by another Life Sciences teacher, Zara, who asked learners to act out what happens during the menstrual cycle, which is often a challenging topic. Zara was pleasantly surprised when a group of learners walked in with tons of bags and dropped bags as they narrated the days going by, displaying the shedding of the uterus lining. This visual, innovative explanation is one that learners will remember because of how unique and memorable it was, compared to lecture-style teaching, or even simply an activity that learners write and then correct. Challenging learners in a differentiated manner expects them to understand the topic enough to be able to apply it in new, interesting ways, which is useful to test their understanding and application. Changing the norm of teaching concerning assessments can be a valuable idea for how assessments can be differentiated. A

lesson can still include an activity at the end, much like many lesson plan templates suggest, but they need not follow a monotonous pattern each day.

Revision often follows the rigid structure of past papers, but it also presents an opportunity for differentiation. For instance, Jordan, when tutoring a learner, used an example from the *Siyavula* learning website to engage her learner in a scenario involving party preparation. Through tasks like converting measurements and calculating food quantities, learners can practice Mathematical Literacy skills in a fun and relatable context, preparing for exams while enjoying the process. This allows teachers to move away from repetitive lessons, that become monotonous and unrelatable to learners. Complex questions, that engage with learner interests benefit struggling learners by making STEM concepts relevant and appealing. Encouraging innovation requires breaking away from rigid teaching norms that constrain differentiation.

5.6.2. Granting Learners Agency, that is How You Shape the Future

When we create monotonous lessons that follow a routine, we risk cultivating learners who all think the same way, and who will not be able to survive in the STEM field once they are in the real world. Thomas Edison failed numerous times before he created the light bulb, Soichiro Honda was ostracised for his car industry ideas, and Isaac Newton started out with farming before he went on to define some of the world's most famous and still used theories of gravity and motion. The field of STEM is competitive and often learners need to know how to navigate this space, which they can, but only if they are enabled the agency to know how to do so. This cannot be done with rigid, structured, unchanging lessons and standardised assessments. To enable agency, we need to enable learner-led lessons, and lessons with inquiry and exploration, discussing the interplay between structure and agency as one where teachers have the agency to alter institutional happenings, as opposed to simply being governed by them.

As teachers are attempting to impart all the knowledge and skills the syllabi require, and assessing their understanding, teachers often forget that one of their roles as teachers is to prepare learners for the real world. Learners will not be around their teachers forever, and so lessons need to enable them to have the agency they need to survive in a world with people who may not consider who they are and what they wish for from life in the way their teachers do. All seven of these teachers believe that differentiation gives them the space to do so, to accelerate learning in a manner that prepares learners for the world beyond school. That is how

teachers shape their future, through giving them the tools to be the ones to work on shaping their future.

The overarching form of teaching that came across throughout these interviews is that of inquiry-based learning. Gholam (2019) defines inquiry-based learning as, “a student-centered instructional approach that makes use of meaningful tasks such as cases, projects, and research to situate learning (Avsec & Kocijancic, 2016)” (p. 113). Gholam (2019) explains that the 21st-century classroom needs to be reassessed, because “learners want to acquire new knowledge by doing”, they want to “think, analyse, evaluate, apply, and create. They want to tell a story, be autonomous, interact, and collaborate. They want to explore and be engaged while using meaningful technological tools” (Gholam, 2019, pp. 112-113). This is something that the STEM teachers at this school believe is the key to differentiation: allowing learners to develop the skills they need to inquire about the world all by themselves—the agency to inquire.

A Physical Sciences teacher, Musa, recounted an experience of his own:

I bought a phone recently and I realised the last one was six years ago. Now, I realise the manuals don't come with phones anymore because they know by playing around with it, inquiring what this is, that is what you actually learn about it. More than if you actually had to read the manual. Imagine if you were taught about it, that's even worse.

Musa mentioned the idea that even as adults, we are continuously inquiring about the world, being curious in our own lives—so how would learners benefit from teaching that is just about handing them information? Learners require teachers to prepare them for the unknown world and to do so teachers have to avoid constraining differentiation. To enable differentiation, teachers need to appeal to learner interests, needs, passions, and capabilities. Enabling agency requires teachers to allow learners to make sense of their learning and take ownership of their learning by allowing them to explore a topic through their own interests and passions. The future of education is one where the teachers let go of their authoritarian role and start mediating and facilitating learning instead. What is the benefit of rigid frameworks that create a hierarchy of power within classrooms, deepening the divide between learner and teacher?

To facilitate learning enables differentiation, in a manner that sees the teacher as someone who aids and assists by providing support, guidance and resources. A teacher should not be one who calls out the answer, but rather the one who guides the learners with resources to help learners understand the topic more effectively because they are the ones that have reached the answer.

Two profound ways of doing this were brought up in this study: (1) Mathematical realisation by Adrian, and (2) access to the outside world by Fiona.

Adrian learnt about the theory of mathematical realisation during his tertiary education. He summarised it as follows:

Mathematical realisation is where you don't just give them the method and tell them how you're going to solve it. Instead, you provide them with the problem or sum in this instance and you ask them, "How would you solve this?" So, that is when you start seeing them think on their own and you see the different methods that they use.

Adrian introduces the lesson by asking learners how they would solve a particular problem, and then he allows learners who completed it differently to explain how they got to the same answer as someone else. This technique enables learner agency because they begin learning how to try different techniques to reach an answer, not allowing them to believe that there is only one fixed manner, or that only one learner can be successful. Mathematical realisation prepares learners with the skill of the real world where the road to a solution is approached in a variety of ways, none of which are entirely incorrect but can only take place if teachers are actively involved in facilitating, and not lecturing.

Fiona supports this because while the introduction to the real world is something that enables differentiation, it does not always need to be the responsibility of a teacher to know how to do so. Sometimes teachers cannot know or advise on everything to do with the real world, and so Fiona provides a solution—take learners into spaces in the real world, or if you cannot afford to do so, bring the real world to them. Fiona as a Mathematics and Mathematics Literacy teacher has the challenge of teaching learners about interest and taxes. This can be very abstract for a learner who has not been exposed to the expenses of taxes and interest. However, she decided to take half of her learners to a bank, and the other half to an established business—each of these learners was then exposed to the importance of knowing what taxes and interests are, piquing their interest as to why they need to know about the topics. While abstract, these subjects in STEM are real-world concepts, and learners need to understand that they become a part of their lives. When teachers cannot take learners on excursions, it was suggested by Fiona that professionals be brought into schools, especially when learners are picking subjects in grade 9, or applying to tertiary institutions during their matric year. By allowing learners the opportunity to be exposed to the real world, letting the authority role of a teacher go, this

enables learner agency because they are exposed to the world which they will one day be a part of.

To be a teacher is a wonderful opportunity, which I myself can vouch for. However, teachers often forget that teaching is not about learners acquiring knowledge to pass an exam, it is about preparing them to be able to be successful in their own way. It is not the fault of a teacher that they cannot be as open to change, if the very structure of the syllabi, their teacher training and the final standardised examinations are not changing. However, to move forward, and begin a new cycle of education, differentiating must and can be enabled. STEM teachers are using marvellous techniques, and it is important that these techniques are shared to create a supportive environment for all teachers.

CHAPTER 6

CONCLUSIONS AND RECOMMENDATIONS

Firstly, and unconventionally, I think it is important that I conclude with how much I have benefitted from this study. As a teacher, myself, navigating the unpredictable nature of creating lesson plans can be so daunting—the fear of learners not passing your subject and having this impact their future is terrifying. When I learnt about differentiation, it was a remarkably interesting practice, giving me a possible solution to the issue many teachers have where some learners in their class understand, and others do not. Framing these learners as ‘unteachable’ is unfair to them, and I am pleased that differentiation has become a buzzword because no learner should feel as though they are ‘unteachable’.

I set out to discover how teachers use differentiation during their STEM lessons because it is a significant topic, especially when our country’s average percentage for Mathematics according to the National Senior Certificate Examination Report in 2022 was 55%, a drop from 2021’s 57.6% (DBE, 2022). According to a Mail & Guardian article by Bongekile Macupe (2021), only 65.8% of Physical Science learners passed the subject, and considering that 174 130 wrote that year, this gives us about 60,000 learners who failed Physical Science. The consequences of learners not having a dedicated support system in STEM subjects are dire, as these are the skilled individuals we need to build our bridges, discover more fossils, invent cures for diseases and navigate natural disasters—these STEM learners are our future. So, whilst South Africa does have inequalities like poverty and a lack of parental support in some spaces, avoiding practising a theory that aims to assist learners in spaces where you can, like differentiation, is unfair to learners. This study aims to be useful to new and upcoming teachers, and to existing teachers who wonder where to start when it comes to differentiation. This is significant because it is a practical example that can help to scaffold all the existing theory articles advocating for differentiation.

The existing literature on differentiation in STEM subjects in South Africa engaged with the challenges a teacher may experience, but also how teachers as agents of education attempt differentiation regardless of any external or internal influence. However, it was important to note that not much literature covers the lesson planning process STEM teachers experience as they differentiate their lessons, drawing from the knowledge of who their learners are. Whilst it was important to note that promoting differentiated learning in South Africa needs to become

a reality, it was important to note the challenges that societal structures and its institutions enforce within classrooms, with the effect of teachers being influenced in a particular manner. Whether a teacher goes to school themselves, gains an education and training for a tertiary institution, or teaches themselves, they are impacted by society which influences the way they plan their lessons.

The results of this research highlight the influences of society on differentiation. Teachers referred to the flaws in the South African education system, denoting how a control over their syllabi constrained differentiation because they were motivated to align their lessons with the syllabi in order to prepare learners for their final examinations which are based on the standards of the syllabi. However, it is important to note that there were many instances of agential action which created a divergent path for teachers, who promoted and carried out differentiation on the basis that their learners needed it and benefitted from it. As a result, this allowed me to reimagine what a transformation of societal structures can look like, where differentiation is enabled more so than it is constrained, simply because of these agential actions.

Critical realism and Archer's theory of morphogenesis was essential to this study as it gave light to the things that were said, but also the things that were not glaringly obvious. The concept of the 'real' and the 'observed' when understanding what factors enable and constrain differentiation displays the multitudes of levels that make up education. The 'observed' factors include factors that enable differentiation such as the awareness of learner-led lessons, and reflexivity, whilst the ones that constrain differentiation include a lack of a supportive environment and a lack of skills practice during teacher training. The 'real' factors that are often not noticeable include structures like departments of education that disseminate knowledge using compulsory syllabi documents like the CAPS and SAG documents, as well as how the culture of teachers as authoritarian figures has become a norm.

Archer's morphogenesis allowed me to understand that there are three major points to note when it comes to differentiation—structure, agency, and culture. When it comes to structures, the very spaces like universities and schools that are supposed to enable education, have their own norms and standards. As a result, whilst there are factors like a supportive work environment that enables differentiation, there are factors that constrain it massively, like standardisation and a lack of practical experience in tertiary institutions that do not provide new teachers with practical experiences of differentiation. This enables a culture across the educational structure, where teachers align themselves with ideals and norms such as revising

or assessing in one particular manner that does not reflect differentiation. However, by spending time with learners, teachers begin to change that culture as their relationship with their learners grows, questioning the norms and conventions of ‘traditional’ teaching techniques in the hope that they can cater for the needs of their learners. This led me to agency, a concept discussed by all seven teachers, who note that a combination of learner agency, learner-led lessons and teacher reflexivity on their learning could lead to a cultivation of agency in the lives of learners that will allow them to survive and hopefully thrive in the world when they leave school and no longer have their teachers supporting them each day.

Differentiation is a daunting space and described by Musa as an ‘organised chaos’ or a ‘messy space’ but, based on the responses from all seven of these teachers who have been attempting it, it has merits and benefits and that is why I know this research has the potential to be significant. Theorists have been discussing differentiation enough for it to become a buzzword, a frequently discussed idea—but what we need more of is discussions from teachers who are doing the challenging work, trying it out, seeing what works, what does not work, and then making recommendations. Teachers in training and those being exposed to differentiation for the first time will significantly benefit from reading about the successes of teachers that they can envision, but they also need to hear about what challenges may arise and where to go or what to try if they need the support.

Teachers need to begin sharing their practices more often, and with a wider reach; this is my recommendation. This has the power to spread pedagogical strategies because highlighting what works in a classroom can encourage other teachers to want to meet the needs of their learners. Always wanting to develop, and staying away from rigid ideas of lesson planning ensures that teachers are always professionally developing and, as such, more research like this can encourage new, prospective, and practicing teachers to attempt differentiation, which has its merits. This invokes stronger collaborative partnerships between teachers, because working in isolation does not allow differentiation to fully move through all schools—teachers need to learn from teachers, and be willing to teach other teachers, or at least share best practices.

Through this conclusion, I hope to encourage continuous improvement. It is important for teachers to always be reflecting on themselves and improving for the benefit of learners. If teachers are regularly reflecting and engaging with others, they can begin to enhance their differentiation strategies. This type of research can continue further, incorporating more contexts within South Africa for researchers to study, and for teachers to be a part of. It is

important for additional studies to cover further factors that constrain and enable differentiation, because it is dynamic, and it will change as time goes by.

Suggestions for Further Research

The outcome of this research provides valuable insights into the factors enabling and constraining differentiation in STEM education within a private school context. However, further research can be done to determine if these are generalised findings, or if they are isolated to the contextual positioning of this school alone. Future studies can expand on this research by exploring different educational contexts, such as public schools, institutions in rural areas, or even tertiary institutions, to determine if the same factors apply. This will allow for a holistic approach to changing the way we teach to enable learning across all contexts. Additionally, there should be research done on the long-term impact of lesson differentiation on learner outcomes across various STEM subjects. This will provide a deeper understanding of the effectiveness of differentiation. Future research can expand on the participant roles, incorporating a broad range of perspectives, including learners and parents. This could provide a more comprehensive view of the challenges and benefits associated with lesson differentiation. Education is a dynamic process and experience, always changing uncontrollably due to the difference in generational eras, as such, this research topic will never be stagnant, always changing and in need of further research to identify the gaps in educational spaces, and to target them by analysing how do learners learn, and what do they need to learn successfully.

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APPENDICES

APPENDIX A

Participation Information Sheet: Observation and Interviews

WITS
UNIVERSITY



Good day

My name is Kerisha Kistoo, and I am a Masters student in the Wits School of Education at the University of the Witwatersrand, Johannesburg. My supervisor is Dr Tebello Letseka. I am doing research studying about lesson differentiation in the field of STEM.

I am inviting you, to take part in an interview. If you decide to take part, your participation in this research study will last about one term. They will comprise of two semi-structured interviews, (1) an observation of you lesson planning and (2) a follow-up interview based on your lesson planning. The interview/research activity will take place at our school during term two of 2023.

With your permission, I would like to audio record the interview. This data will be stored on my password protected personal laptop until completion of my qualification and deleted after I pass my qualification. Only myself, as a researcher, and my supervisor will have access to the data.

During the research activity, I will need to ask for some teaching-related information about you, including how you go about creating a lesson plan for your classes and why you choose to teach in the way that you do.

The interview will be confidential and anonymous. When I share the results of the research study, I will not include your name or anything else that could identify you.

If you decide to take part in the research study, it should be because you want to volunteer. You do not have to take part. You can stop being in the study at any time. You do not have to answer any questions if you do not want to. You will not get any direct benefits if you choose

to join the research study. You will not lose any services, benefits, or rights you would normally have if you decided not to join. Taking part in the research study will not cost you anything. You will not be paid for being in this research study.

The risks for this research study are no more than what happens in everyday life. If you feel uncertain at any point, I will stop the interview immediately and continue another time.

This research study will be written up as a research report. The report will be available on the university library website. If you would like to receive a summary of this report, I will be happy to send it to you.

If you have any questions during or afterwards about this research study, feel free to contact me or my supervisor on the details listed below. If you have any concerns or complaints about the ethical procedures of this research study, you are welcome to contact the University Human Research Ethics Committee (Non-Medical), telephone +27(0) 11 717 1408, email hrecon-medical@wits.ac.za.

Yours sincerely,

Kerisha Kistoo

Researcher:

Kerisha Kistoo; 1108735@students.wits.ac.za; 082 717 6360

Supervisor:

Dr Tebello Letseka; tebello.letseka@wits.ac.za; 011 717 3096

APPENDIX B

Google Form Questions and Consent Form

WITS
UNIVERSITY



Title: A Critical Realist account of the factors that enable and constrain lesson differentiation in STEM Education: A case study of a private school in the Eastern suburbs of Johannesburg

Name of Researcher: Kerisha Kistoo

Question	Response
1. Do you agree that the research study was explained to you?	YES/NO
2. Do you understand what this study is about?	YES/NO
3. Do you agree that your participation will remain anonymous (your name will not be used in my final research report)?	YES/NO
4. Do you agree to be a part of this study?	YES/NO
5. Please fill in your full name	ANSWER
6. What subject/s do you teach?	ANSWER
7. What topics are you teaching this term?	ANSWER
8. What skills are you teaching this term?	ANSWER

APPENDIX C

Consent Form: Observations

WITS
UNIVERSITY



Title: A Critical Realist account of the factors that enable and constrain lesson differentiation in STEM Education: A case study of a private school in the Eastern suburbs of Johannesburg

Name of Researcher: Kerisha Kistoo

I, _____, agree to participate in this research project. I agree to the following:

[Please circle the relevant options below]

The research study was explained to me. I understand what this study is about.	YES	NO
I understand that I can volunteer to take part in the study.	YES	NO
I agree that the interview may be audio recorded.	YES	NO
I agree that direct quotations from my interview may be used by the researcher in their research report.	YES	NO
I agree that images of my lesson plan or sections of my lesson plan may be used by the research in their research report.	YES	NO
I agree that my participation will remain anonymous (my name will not be used by the researcher in their research report).	YES	NO

_____ (signature)

_____ (name of participant)

_____ (date)

_____ (signature)

_____ (name of researcher)

_____ (date)

APPENDIX D

Observation Schedule

WITS
UNIVERSITY



GENERAL LESSON PLANNING OBSERVATION SCHEDULE		
Activity	General Timeframe	Notes, comments, or reflections
Repetition of Explanation of Research and Observation Plan	5 Minutes	<ul style="list-style-type: none"> • Clarification of questions • Confirmation of understanding of research
Collection of Consent Forms and Beginning of Recording	2 Minutes	<ul style="list-style-type: none"> • Confirmation of consent to be a part of the interview process and to be recorded
Clarification of Lesson Plan Method – Teachers explain how they will be planning their lesson	5 Minutes	<ul style="list-style-type: none"> • Confirmation of mode of lesson planning
Teacher explains lesson planning process	Approximately 18 Minutes (may take more time, depending on the teacher/topic)	<ul style="list-style-type: none"> • Teacher explains their process of differentiating lesson plans • Researcher notes any important detail that may pertain to follow-up questions or prompts
Closing of Interview	1 Minute	<ul style="list-style-type: none"> • Explain the process of listening to the recording, and creating prompts and questions for the follow-up interview

APPENDIX E

Consent Form: Semi-Structured Interview

WITS
UNIVERSITY



Title: A Critical Realist account of the factors that enable and constrain lesson differentiation in STEM Education: A case study of a private school in the Eastern suburbs of Johannesburg

Name of Researcher: Kerisha Kistoo

I, _____, agree to participate in this research project. I agree to the following:

[Please circle the relevant options below]

The research study was explained to me. I understand what this study is about.	YES	NO
I understand that I can volunteer to take part in the study.	YES	NO
I agree that the interview may be audio recorded.	YES	NO
I agree that direct quotations from my interview may be used by the researcher in their research report.	YES	NO
I agree that images of my lesson plan or sections of my lesson plan may be used by the research in their research report.	YES	NO
I agree that my participation will remain anonymous (my name will not be used by the researcher in their research report).	YES	NO

_____ (signature)
_____ (name of participant)
_____ (date)

_____ (signature)
_____ (name of researcher)
_____ (date)

APPENDIX F

Prompts and Possible Pre-determined Questions for the Semi-Structured Interview

WITS
UNIVERSITY



- 1) Why do you choose to introduce your lesson in this manner?
- 2) Explain the reason behind this particular activity.
- 3) What experiences caused you to believe that this particular activity was the best one in terms of disseminating knowledge?
- 4) How do you pre-empt questions?
- 5) How do you incorporate multimodal teaching practices into your lessons?
- 6) Why did you choose this particular practice to teach this topic?
- 7) How do you go about gaining an understanding of learning comprehension?
- 8) Are your activities differentiated as well?
- 9) What was the process of learning how to differentiate your lessons in this STEM subject?
- 10) How do you teach in an inclusive manner, knowing that there are learners with a variety of learning needs, abilities, and barriers?
- 11) How are these needs, abilities and barriers addressed in your lesson planning to avoid excluding or isolating learners who learn in differing ways?

APPENDIX G

School Permission Form

WITS
UNIVERSITY



Date

Good day Executive Department

My name is Kerisha Kistoo, and I am a Masters student in the Wits School of Education at the University of the Witwatersrand, Johannesburg. My supervisor is Dr Tebello Letseka. I am doing research studying about lesson differentiation in the field of STEM.

As a school that readily attempts to integrate and include learners with all learners needs and abilities in your classrooms, I believe [school name] will be the perfect and safest space for my research. With your permission, I would like to carry out my research, interviewing teachers who teach in the STEM (Science, Technology, Engineering and Mathematics) fields, including but not limited to Natural Sciences, Physical Sciences, Life Sciences, Geography, Information Technology, Mathematics, Mathematical Literacy, Technology and Design and Food Technology teachers

During the research activity, I will ask teaching-related and lesson planning-type questions, including how teachers go about creating a lesson plan for their classes and why they choose to teach in the way that they do. The entire interview process will be as confidential and anonymous as possible, with only myself and my research supervisor accessing information that was discussed. When I share the results of the research study, I will not include any names or anything else that could identify any teacher, or the school.

All interview participants will not be coerced or forced into taking part in this research study, it will be entirely on a volunteer basis. The interview may be stopped at any time and interviewees may choose not to answer any questions. Interviewees may also choose to answer certain questions and not others or choose to answer only certain parts of the questions asked. They will not receive direct benefits if they choose to join the research study, and neither will they lose any services, benefits, or rights that they would normally have if they decide not to join. The risks for this research study are no more than what happens in everyday life. If participants feel uncertain at any point, I will stop the interview immediately and continue another time.

This research study will be written up as a research report. The report will be available on the university library website. I will send both a link, and a PDF copy of my research report upon completion to the school. I will also print a hard copy if the school requests it.

If you have any questions during or afterwards about this research study, feel free to contact me or my supervisor on the details listed below. If you have any concerns or complaints about the ethical procedures of this research study, you are welcome to contact the University Human Research Ethics Committee (Non-Medical), telephone +27(0) 11 717 1408, email hrecnon-medical@wits.ac.za.

Yours sincerely,

Kerisha Kistoo

Researcher:

Kerisha Kistoo; 1108735@students.wits.ac.za; 082 717 6360

Supervisor:

Dr Tebello Letseka; tebello.letseka@wits.ac.za; 011 717 3096

APPENDIX H

Wits School of Education Ethics Clearance Form



SCHOOL OF EDUCATION ETHICS COMMITTEE

CONSTITUTED UNDER THE UNIVERSITY HUMAN RESEARCH ETHICS COMMITTEE (NON-MEDICAL)

CLEARANCE CERTIFICATE

PROTOCOL NUMBER: 2023ECE007

PROJECT TITLE

A Critical Realist account of the factors enabling and constraining lesson differentiation in STEM Education: A Case Study of a private school in the Eastern suburbs of Johannesburg

INVESTIGATOR

KISTOO KERISHA

SCHOOL/DEPARTMENT OF INVESTIGATOR

Wits School of Education

DATE CONSIDERED

06-Mar-23

DECISION OF THE COMMITTEE

Approved unconditionally

RISK LEVEL

Low risk

EXPIRY DATE

Date of submission of the Research Report

ISSUE DATE OF CERTIFICATE

20-Mar-23

CHAIRPERSON

Dr. Batseba Mofolo-Mbokane

cc: Dr Tebello Letseka

DECLARATION OF INVESTIGATOR

To be completed in duplicate and ONE COPY returned to the Chairperson of the School/Department ethics committee.

I fully understand the conditions under which I am authorized to carry out the abovementioned research and I guarantee to ensure compliance with these conditions. Should any departure to be contemplated from the research procedure as approved I/we undertake to resubmit the protocol to the Committee.

Signature

Date 2 1, 0 3, 2 0 2 3

APPENDIX I

Department of Basic Education Ethics Clearance Form



GAUTENG PROVINCE

Department: Education
REPUBLIC OF SOUTH AFRICA

B/4/4/1/2

GDE RESEARCH APPROVAL LETTER

Date:	27 February 2023
Validity of Research Approval:	08 February 2023– 30 September 2023 2023/76
Name of Researcher:	Kistoo K
Address of Researcher:	13 Teak Avenue Extension 6 Lenasia
Telephone Number:	082 717 6360
Email address:	1106735@students.wits.ac.za
Research Topic:	A Critical Realist account of the factors enabling and constraining lesson differentiation in STEM Education: A Case Study of a private school in the Eastern suburbs of Johannesburg
Type of qualification	Masters
Number and type of schools:	1 Secondary School
District/s/HO	Johannesburg East

Re: Approval in Respect of Request to Conduct Research

This letter serves to indicate that approval is hereby granted to the above-mentioned researcher to proceed with research in respect of the study indicated above. The onus rests with the researcher to negotiate appropriate and relevant time schedules with the school/s and/or offices involved to conduct the research. A separate copy of this letter must be presented to both the School (both Principal and SGB) and the District/Lead Office Senior Manager confirming that permission has been granted for the research to be conducted.

[Signature] 28/02/2023

The following conditions apply to GDE research. The researcher may proceed with the above study subject to the conditions listed below are met. Approval may be withdrawn should any of the conditions listed below be flouted:

Making education a societal priority

Office of the Director: Education Research and Knowledge Management

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