EXPLORING TEACHER IDENTITIES AND EMOTIONS IN THE TEACHING OF ORGANIC CHEMISTRY IN GRADE 12 TECHNICAL SCIENCES

By

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A dissertation submitted in fulfilment of the requirements for the degree of Masters in Education in

Teacher Development Studies

COLLEGE OF HUMANITIES

SCHOOL OF EDUCATION

UNIVERSITY OF KWAZULU-NATAL

PIETERMARITZBURG

2024

DECLARATION

This dissertation has been submitted in fulfilment of the requirements for the degree of Masters in Education in the Postgraduate Programme of the College of Humanities, University of KwaZulu-Natal, Pietermaritzburg, South Africa.

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Date: 13/07/2024

Name of Supervisor: Dr Jaqueline Naidoo

Signature: 

Date: 13/07/2024

DEDICATION

This dissertation is dedicated to my parents, Mr S.D Mkhabela and Mrs S.N Mkhabela for their spiritual support, encouragement and creating a positive environment for me to achieve my goal. To my sisters, Sinenhlahla Masondo and Pamela Mzimela, for believing in me and always being there for me when I lost hope. To my brother, Makabongwe Mkhabela, for being my technician and motivating me. To my children, Lethokuhle Fakude, Minenhle Fakude and Siphosethu Fakude who were there for me throughout.

ACKNOWLEDGEMENTS

I would like to thank God for guiding me and giving me the strength to complete this dissertation.

I further extend my honest appreciation to the following people and institutions for their contributions to the successful completion of this dissertation:

1. My supervisor, Dr Jaqueline Naidoo for her continuous support, guidance and encouragement.
2. Dr Bongiwe Zulu for encouraging me to further my studies.
3. The five participants who helped me to complete this study.
4. My dearest friends who supported me during my time of need.
5. My study colleagues: Xoliswa Memela, Owami Momoza, Sisanda Dlamini for always being there for me encouraging me, and staying with me until this study was complete.
6. My family: Mom, Dad, Sinenhlahla, Pamela, and Makabongwe for motivating me, checking up on me, and praying for me to have a strength of completing against all odds.
7. My children: Lethokuhle, Minenhle, and Siphosethu for understanding.

PREFACE

The research study described in this dissertation was carried out with five teachers from Harry gwala and Ugu Districts in the Province of KwaZulu Natal. This project began in May 2023 and ended in June 2024, under the supervision of Dr Jaqueline Naidoo of the Pietermaritzburg campus, University of KwaZulu Natal.

This study represents the original work completed by the author and has not been submitted in any form for any diploma or degree to any other tertiary institution. Where the author has made use of the work of other authors, this has been duly acknowledged in the text.

[redacted]

Nomthandazo Fakude Date: 13/07/2024

As the candidate's supervisor, I agree/do not agree to the submission of this dissertation.

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Dr J. Naidoo Date: 13/07/2024

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ABSTRACT

Organic chemistry is one of the topics taught in technical sciences, and the manner in which learners adapt to organic chemistry depends on teachers' teaching approach. This study explored the identities and emotions of teachers teaching technical sciences in grade 12 classes in the Harry Gwala and Ugu Districts in KwaZulu-Natal, South Africa. Furthermore, this study examined how teachers' identities and emotions influenced their teaching of organic chemistry. This study adopted Gu and Day's (2007) three dimensions of teacher identities as well as Hargreaves's (2001) emotional geographies of teaching as conceptual frameworks. This study was located within the interpretive paradigm and adopted a qualitative approach. The narratives were constructed from data generated through semi-structured interviews and collages. Five grade 12 technical sciences teachers participated in this study.

The findings of this study reveal that teachers teaching technical sciences have diverse identities and mixed emotions when teaching organic chemistry. Data showed that the situated, professional, and personal dimensions of teacher identity overlapped and influenced each other. Teachers were found to have mixed emotions when teaching organic chemistry in technical science classes. Teacher emotions were influenced by the availability of resources, parental and school management team support, and teacher knowledge. This study also found that teacher emotions influenced the teaching of organic chemistry in technical sciences classes. When teachers have positive emotions about teaching organic chemistry, learners also feel eager and enthusiastic to learn and as a result, learners achieve good marks. Concurrently, if teachers have negative feelings about teaching organic chemistry, they do not feel confident to teach hence learners feel demotivated and discouraged to learn, resulting in poor performance of learners. Additionally, the trends of closeness and distance in socio-cultural, moral, physical, political, and professional geographies shape the emotions experienced by teachers through communication.

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DBE: Department of Basic Education

PAT: Practical Assessment Tasks

JIT: Just In Time

Chapter 1

Introduction and Background to the Study

1.1 Introduction

This chapter outlines the purpose of this study which examined the narratives of grade 12 technical sciences teachers' identities and emotions at five schools, two in the Ugu district and three in the Harry Gwala district, in KwaZulu-Natal, South Africa. This is followed by a brief description of the methodological approach used to conduct this research. Next, the conceptual frameworks employed in this study is discussed. The chapter concludes with an overview of the chapters in the dissertation.

1.2 Purpose of the study

Teacher identity influences the effectiveness of teachers and enables them to flourish in their classroom practices (Ó Gallchóir, O'Flaherty, and Hinchion, 2018). Nevertheless, teaching is an emotional practice; teacher emotions also measure the effectiveness of a teacher in achieving curriculum needs (Thomas et al., 2016). The purpose of this study was to examine the identities and emotions of teachers teaching technical sciences in grade 12 classes in the Harry Gwala and Ugu Districts of KwaZulu Natal. Furthermore, the study aimed to explore how teachers' identities and emotions influence their teaching of organic chemistry in grade 12 technical sciences classes. The objectives of this study were:

- To explore the identities of teachers teaching organic chemistry in grade 12 technical sciences classes.
- To explore the emotions of teachers teaching organic chemistry in grade 12 technical sciences classes.
- To examine how the emotions of teachers influence the teaching of organic chemistry in grade 12 technical sciences classes.

1.3 Research questions

This study was guided by the following research questions:

1. What do grade 12 technical sciences teachers' stories tell us about their personal and professional identities and their teaching of organic chemistry?

2. What emotions do grade 12 technical sciences teachers experience when teaching organic chemistry?
3. How do grade 12 technical sciences teachers' emotions influence their teaching of organic chemistry?

1.4 Background

Organic chemistry is one of the topics taught in the physical sciences and technical sciences grade 12 curricula. It has been observed that there is a challenge in teaching and learning the organic chemistry topics. Thus, much research has been done to find ways of improving learners' performance in organic chemistry. Iyamuremye et al. (2022) illustrate that to improve learners' performance in organic chemistry, learners should practice web-discussion, a learning strategy that promotes collaborative learning. However, this method might be difficult in schools that are located in rural areas and do not have internet access or have poor internet connectivity due to load shedding.

This study aimed to examine the influence of teachers' identities and emotions on teaching organic chemistry in grade 12 technical sciences classes. Technical sciences is a relatively new subject introduced in schools in the province of KwaZulu-Natal, and the first grade 12 technical sciences class was taught in 2019. According to the Department of Basic Education (DBE, 2011), the technical sciences subject was introduced to promote technology studies in South Africa. Moreover, technical sciences aim to support learners in three areas, namely: mechanical technology, electrical technology, and civil technology.

Global advancements in technology led to the introduction of technical sciences as a school subject in South Africa; and the curriculum intends to develop candidates with better technological skills (DBE, 2011). The South African curriculum also aims to ensure that knowledge acquired by learners in schools makes sense and is meaningful to their lives. "There are six main knowledge areas taught in the technical sciences subject", namely: "mechanics, matter and materials, electricity and magnetism, waves, sound and light, heat and thermodynamics, and chemical change". Some of the skills that must be acquired by learners doing technical sciences include: problem-solving, hypothesising, measuring, and communicating (DBE, 2011). Therefore, technical sciences teachers need to ensure that all topics are covered and that learners acquire these skills through teaching and learning activities.

According to Martínez-Torregrosa et al. (2018), however, the introduction of a new subject might lead to poor performance of learners, due to teachers lacking subject knowledge of the new curriculum.

Organic chemistry is a key topic taught under matter and materials and has a weighting of 36% in paper two of technical sciences. In the province of KwaZulu-Natal, it has been five years since technical sciences were introduced to grade 12 learners. This study focused on the identities and emotions of grade 12 technical sciences teachers and examined how teachers' identities and emotions influenced their teaching of organic chemistry in technical sciences.

1.5 Rationale

Khayal (2019) confirms that technical education assists students to develop theoretical knowledge together with practical skills which enable them to improve their quality of living. However, Tomáš Kozík (2015) asserts that there is a gap in the technical education in primary schools as the education system has a negative attitude towards the technical education of primary school learners.

This study explored the identities and emotions of teachers teaching technical sciences in grade 12. This study's objective was to understand how teachers' identities and emotions influence their teaching of organic chemistry in a technical sciences grade 12 class. As technical sciences is a newly introduced subject, literature is scarce on how teachers feel about teaching technical sciences. This study aimed to fill that gap. Kelani and Gado (2018) found that several factors influence the implementation of technology education in physical sciences classrooms, such as lesson plans, large classes, and students being unable to understand the instructional language. Furthermore, Ngema and Lekhetho (2019) found that most science and mathematics teachers have good-quality of content knowledge but lack the skills to implement it in their classrooms effectively. Most research is on physical sciences, however, not technical sciences.

Teachers' identities influence teachers' practices, and one difficulty for new teachers is developing a better understanding of the multifaceted and complex dimensions of teacher identity and how it influences their teaching practices (Ó Gallchóir, O'Flaherty, and Hinchion , 2018). Since technical sciences is a relatively new subject and teachers who are teaching it are mostly trained to teach physical sciences, although some topics are not new to them, the requirements for teaching them are different. In physical sciences, learners need to be able to deduce and develop theory, in contrast, technical sciences requires learners to bring theory into practice. The technical sciences syllabus is different from that of physical science in that 50%

of the pass mark comprises school-based assessments while the other 50% comprises Practical Assessment Tasks (PATs). This highlights the need for this study to explore the personal and professional identities of grade 12 technical sciences teachers, and how their identities influence their technical sciences teaching.

According to Hargreaves (2001), teaching involves emotions and relationships among teachers, parents, and learners. Furthermore, team teaching contributes to teachers' emotional and moral support as they share new ideas and opinions and support each other. Hargreaves (2001) argues that little research has been done on the emotional support of teachers. Although, Brígido et al. (2010) conducted a study on primary and secondary teacher emotions in teaching natural sciences, there is still a gap in the literature based on the emotions of teachers teaching technical subjects.

I was motivated to conduct this study because I am a technical sciences teacher who has taught organic chemistry in a physical sciences class. Through my experience, I observed that it is easier to complete organic chemistry topics in physical sciences classes than in technical sciences classes. In my technical sciences classes, I always experienced difficulties in completing the organic chemistry topics in one period as prescribed by the annual teaching plan. This led to anxiety and stress because I did not have enough time to revise which resulted in my learners performing poorly in the organic chemistry topics. This also led to me questioning my role as a technical sciences teacher and whether I was a good or poor technical sciences teacher. My learners' poor performance in grade 12 technical sciences also negatively influenced my self-esteem. This served as a personal rationale to conduct this study.

1.6 Overview of key concepts

Teacher identity is a concept that defines the teachers' role in teaching (Tateo, 2012). The school environment, changes in society and policy, and teachers' experiences are some of the factors that influence the development of a teacher's professional identity. Sun et al. (2022) also emphasises that teaching is driven by positive emotions and that teachers' professional identities may change depending on what teachers have to deal with in their daily lives. Furthermore, social pressure from the school context, migration from society, new educational practices, technological changes, and new laws introduced may affect teachers' professional identities. With such changes, teachers' professional identities have to be understood to ensure that teachers' roles are developed according to learning objectives.

Beijaard et al. (2004) define teacher professional identities as who a teacher is at a current instance, considering how teachers see the teaching profession, the roles and strategies they use when teaching, and what they should know and do. In addition, teachers' professional identities are influenced by individual contexts such as school and society. Sun et al. (2022) contends that a teacher's professional identity is a product and process, and also a tool for sense-making. Contextual factors play a vital role in the process of developing a teacher identity. Teachers' experiences within the environment they work in are likely to influence the development of their teacher identities.

Considering teacher professional identities in education research is very important. Zembylas and Chubbuck (2018) emphasises that seeking the understanding of teachers' professional identities will help to understand teachers' work and their roles. Furthermore, the understanding of teachers' professional identity formation process is central to understanding the professional learning and development needs of teachers. Individual teacher identities in this study were considered in different contexts (teaching environments) which enabled me to understand how teacher identities influence their teaching of organic chemistry.

Emotions are one of three important mental processes that are inter-reliant in defining human beings and their relationship to the environment (Keller et al., 2014). In the study, the nature of emotions in the teaching of organic chemistry was examined within the school context. Teachers' emotions need to be understood in the school's context since they are an integral part of the education activity setting (Pekrun and Linnenbrink-Garcia, 2014). Furthermore, teachers' emotions influence instructional behaviour which then influences learners' behaviours in class and affects the achievement of teachers' goals. Keller et al. (2014) argue that teachers' emotions play a huge role in teachers' sense of job fulfilment.

Teaching and learning technical sciences have an emotional dimension. For one to understand the process of teaching and learning it is necessary to examine the emotional and cognitive aspects involved Lasky (2005). In addition, it is vital to understand the change revealed by teachers' experiences and their emotions. Since emotions are involved in the process of teaching, they are not only a product of the nature of teaching. Rather, they are also indicative of how particular ways of teaching are being organised to shape emotions in teaching.

1.7 Conceptual framework

This study was underpinned by two conceptual frameworks: the three dimensions of teacher identities by Gu and Day (2007) and emotional geographies of teaching by Hargreaves (2001).

Gu and Day (2007) outline teacher effectiveness and assert that for teachers to be effective in their teaching they should be able to recover from difficulties they come across. Furthermore, the recovery may be determined by the interaction between the internal assets and the external environment where the individual subsists and matures. Gu and Day (2007) examine teachers' effectiveness and consider factors that hinder teachers from keeping their motivation, commitment, and effectiveness in the profession. It is vital to know the interaction between work and life throughout a career, and the different contexts in which teachers work.

Gu and Day (2007) observe that three dimensions of teacher identities are key influencers of teacher effectiveness. The first dimension is the personal dimension; this is related to the teachers' life in school. This dimension involves the positive and negative emotions of a teacher that may lead to the teacher's actions, and the relationship between the teacher and learners which affect activities that take place in classrooms (Gu & Day, 2007). The second dimension is the situated dimension, which is related to teachers' lives outside school. Teachers' families, the society they live in, and their lives outside school shape their decision-making and the ways they respond to challenges they face at school. The third dimension is the professional dimension, which is related to teachers' values, beliefs, and the interaction between these and external policy agendas (Gu & Day, 2007). Furthermore, changing policies and increasing workloads seem to put pressure on teachers and tend to influence teacher effectiveness.

The three dimensions of a teacher's identity cannot be separated because they interact with one another. According to Gu and Day (2007), if a teacher experiences a change in these dimensions, this influences the stability of their identities. My study was based on teachers teaching grade 12 technical sciences who had shifted from teaching physical sciences to technical sciences. These three dimensions of teacher identities helped me to analyse the influence of their identities as they changed from teaching physical sciences to technical sciences. Learners look up to teachers who can recover from difficulties caused by new policy changes as this makes it easy for learners to cope with policy changes. Gu and Day's (2007) framework on the three dimensions of teacher identity assisted to analyse research question one which focused on personal and professional identities of grade 12 technical sciences teachers.

Hargreaves (2001) identifies five emotional geographies of teaching, namely, socio-cultural, moral, physical, political, and professional. Emotional geographies describe the trends of closeness and distance in communication with self, others, or the world around us that shape

the emotions experienced through communication. Sociocultural geography refers to teachers' awareness of learners' cultural diversity in the classes they teach. The classroom consists of learners coming from different working-class lower, middle, or upper-class families. This results in teachers being at a sociocultural distance from many students' backgrounds. Furthermore, teachers teach learners to whom they are not physically, socially, and culturally close. Thus, teachers end up categorising all learners based on the culture of the community. Teachers tend to predict parental interest in their learner's education based on assumptions about the culture of their community. Sociocultural geography also describes teachers' perceptions of parents' interaction or impact on their learners' education. Therefore, teachers' working conditions should provide access to their learners' cultural knowledge and emotional understanding to close the sociocultural gap between them. This would help teachers to deal effectively with troublesome parents.

The moral geography describes the state of teachers being honoured or not by parents. Teachers receive positive emotions if they are valued, appreciated, and supported by parents. The moral distance between teachers and parents can be measured through the awareness of parents of their child's learning progress and the support they give to teachers. The moral support that parents give to teachers based on the good work teachers do for their learner's education brings positive emotions to teachers, which impact positively on their teaching. The indication of moral closeness of teachers and parents is moral agreement and support, which shows appreciation. Teachers experience negative emotions when there is a great distance between them and others, especially if the distance causes teachers not to achieve their purpose. Misunderstandings and conflicts between parents and teachers are regarded as moral distances that create negative emotions for teachers and lead to them being ineffective in their teaching. Teacher emotions are triggered by their purposes, and narrowed by their choices. Teachers experience happiness when they achieve their goals and purpose.

The professional geography involves maintaining the relationship between teachers, parents, and learners in a professional way. Teaching can also include taking care of learners. Therefore, teachers are expected to take care of learners in a professional way. The closeness of parents and learners to teachers professionally is based on the degree to which teachers are trusted and acknowledged as the professionals, and their instructional knowledge not questioned. Teachers develop positive emotions if they receive positive feedback from parents based on their judgements. However, teachers avoid parents' criticism by creating a distance in communicating with parents. Such distance prevents teachers from getting support from

parents. Professional distance is also part of the physical distance in parent and teacher interactions.

Physical geography determines how often teachers and parents interact with each other. Smaller physical distance enables parents and teachers to understand each other. The interaction between teachers and parents can be formal or informal. Hargreaves (2001, p.1071) contends that "physical distance of rare and non-face-to-face communication that can make emotional understanding and strong partnerships between teachers and parents even more difficult to establish strong partnerships between teachers and parents even more difficult to found". Keeping a close physical distance allows teachers to understand the learners they teach and their background.

Finally, in the political geography, political distance is whether teachers are powerful or powerless to achieve their purposes. Teacher emotions are also influenced by emotional politics. Teachers work under the authority of principals, which sometimes leaves them powerless when it comes to decision making. The authority of the principal might bring frustrations and negative emotions to teachers. However, power and authority develop positive emotions to teachers; if teachers are granted power over their work, they feel satisfied with doing their work. Power enables teachers to discontinue the criticism of parents about their instructional judgements and knowledge. Additionally, the emotional politics of teacher and parent interactions are difficult. When professional and physical distance is not maintained, teachers might find themselves experiencing negative emotions as a result of parents and school leadership.

1.8 Methodological approach

This study was located within the interpretive paradigm and adopted a narrative inquiry research design to generate stories about technical sciences teachers' identities and emotions. Ntinda (2018) asserts that narrative inquiry focuses on the experiences of people and how they understand and describe aspects of their lives. Similarly, Foxall et al. (2021) reveal that narrative inquiry is a method of sharing the experiences of participants in the form of a story. In the same vein, Foxall et al. (2021) emphasise that narrative inquiry is grounded in understanding human beings and their experiences through storytelling. Narrative inquiry was appropriate for this research study as the teachers' identities and emotions were complex and challenging to understand.

In narrative inquiry, the participants are considered experts and hold power as they are able and allowed to tell their own stories Barkhuizen and Consoli (2021). Narrative analysis puts people at the heart of research inquiry ensuring that their voices are heard (Leedy & Ormrod, 2018). In this study, data was generated using semi-structured interviews and collages. According to Kumar (2014), an interview is a verbal conversation between two people to collect relevant information for research. Similarly, Jacobsen (2020) assert that the interview is a process of communication or interaction in which the subject or interviewee gives the needed information verbally in a face-to-face situation. Wilson, Mandich and Magalhães (2016) describe a collage as the process in which pictures or images are cut and pasted onto a surface to illustrate the phenomenon under study. One can express their thoughts and provide an in-depth understanding of their lived experiences when designing collages.

The purpose of this study was to explore how the personal and professional identities and emotions of grade 12 technical sciences teachers influence their teaching of organic chemistry. The purposive sampling procedure was used to select participants. Purposive sampling is a strategy where participants are selected intentionally to generate important information that cannot be obtained from other selections (Taherdoost, 2016). Butler-Kisber and Poldma (2010)describe purposive sampling as a procedure where the researcher deliberately selects a particular group of participants because they possess distinctive characteristics for which the researcher is looking. The sample size comprised five grade 12 technical sciences teachers teaching organic chemistry in five secondary schools in the Harry Gwala and Ugu Districts. The five grade 12 technical sciences teachers were selected as participants because they had more than three years of experience and were able to provide relevant information and data to respond to the research questions.

1.9 My personal narrative

I completed my secondary schooling in 2010. I studied towards my Bachelor of Education degree at the University of KwaZulu-Natal and majored in physical sciences and mathematics. In secondary school, I had a good, dynamic physical sciences teacher who made the lessons exciting and interesting and I enjoyed these lessons. This highlighted for me that who teachers are, that is, their identity, and their emotions and passion for teaching influence the teaching and learning in the classroom. Organic chemistry was my favourite topic in secondary school, and I looked forward to tests that focused on organic chemistry. I would always prefer to start learning for tests and examinations on organic chemistry before learning the other topics and

subjects. My love for organic chemistry developed further during tertiary education, where the microscopic aspects and practical experiments were conducted fascinated me. I am currently a qualified, post-level one physical sciences and technical sciences teacher at a secondary school teaching grades 10 to 12.

My first experience of teaching organic chemistry was in my physical sciences class. My enthusiasm for teaching the organic chemistry topic was evident to learners and I was happy to see that my learners also enjoyed learning about organic chemistry. It was always easy to complete the sections on organic chemistry in the physical sciences class and my learners always performed well in this topic. Therefore, I had good self-esteem, believed I was a good teacher, and developed positive emotions toward teaching organic chemistry in physical sciences.

In 2016, technical sciences was introduced as a grade ten subject in my school. I was tasked with teaching it and my first grade 12 class was in 2019. Switching from physical sciences to technical sciences was not as easy as I expected it to be. I thought it would be easy to teach organic chemistry in technical sciences and the topics taught would be the same as in physical sciences. However, I found it difficult to complete organic chemistry in the technical sciences class. I have observed that for technical sciences learners to master organic chemistry, they need much more time for teaching and revising, and some learners do not perform very well. This resulted in me having a poor self-esteem and negative emotions when I had to teach organic chemistry in technical sciences because I needed to apply different teaching strategies for my learners to understand this topic. Thus, I was interested in exploring technical sciences teachers' professional identities and their emotions, and how these influenced their teaching of organic chemistry in grade 12 technical sciences classes.

1.10 Overview of Dissertation Chapters

This dissertation comprises five chapters which are summarised as follows:

Chapter one outlines the purpose, background, and rationale of the study. It also outlines the research questions and the overview of key concepts. The conceptual frameworks adopted in this study are also described. The overview of the methodological approach and my narrative based on my experience of teaching organic chemistry is explained. Chapter one concludes with a brief overview of the structure of the chapters in this dissertation.

Chapter two provides a literature review of the relevant key concepts, teacher identity and teacher emotions. Teachers' professional and personal identities and how these contribute to effective teaching are discussed. The literature review also outlines technical sciences teaching and effective teaching of organic chemistry. This chapter concludes with an overview of the conceptual frameworks adopted in the study, namely, Gu and Day's (2007) three dimensions of teacher identity and Hargreaves's (2001) notion of the five emotional geographies.

Chapter three, discusses the methodological approach employed in this study. The study was located within the interpretive paradigm and adopted the qualitative methodological approach. In addition, this chapter discusses the narrative approach, research context, and purposive sampling method. The data generation methods, namely, semi-structured interviews and collages, are also described. This chapter concludes with a discussion of trustworthiness and the ethical issues considered in this study.

Chapter four presents data analysis, using data generated in this study. Data is presented according to the research questions. Data generated in this study was drawn from the narratives of the five participants using semi-structured interviews and collages. The findings are analysed and discussed adopting the lenses of the conceptual frameworks of this study and relevant literature.

Chapter five provides a summary of the five chapters in this dissertation. It outlines the strengths of the methodological approach and conceptual framework. It also summarises the key findings of the study and outlines its limitations. Chapter five concludes with recommendations for future research.

1.11 Conclusion

This chapter outlined the purpose of the study and briefly discussed the background and rationale of the study. This chapter also presented the research questions and an overview the key concepts underpinning the study. Furthermore, the methodological approach and conceptual framework employed in this study were outlined. A brief outline of my personal narrative was presented, and this chapter concluded with a brief overview of the five chapters in this dissertation.

Chapter 2

Literature Review

2.1 Introduction

This study explored the professional identities and emotions of teachers teaching organic chemistry in technical sciences grade 12 classes in the Harry Gwala and Ugu districts. It further examined how the professional identities and emotions of teachers influenced their teaching of organic chemistry in technical sciences grade 12 classes. This chapter begins with an outline of the concept of teacher identity to enhance the understanding of the concept. This is followed by a discussion of teachers' personal and professional identities. Next, teacher emotions are discussed, followed by an outline of the technical sciences subject. Finally, effective teaching in organic chemistry is discussed before the chapter concludes by outlining the conceptual framework which comprised of Gu and Day's (2007) three dimensions of teacher identity and Hargreaves's (2001) emotional geographies of teaching.

2.2 Teacher identity

According to Lutovac and Flores (2021), the concept of teacher identity is continually being defined. Beijaard et al. (2004) define teacher identity as a mental, philosophical, and social construct. They assert that teacher identity is molded by social, cultural, and political situations. In the same vein, Reeves (2018, p.1) describes teacher identity "as a term that embraces the person's social roles which include the social statuses, roles, positions, relationships, and institutional and other relevant community identities one may attempt to claim or assign in the course of social life". On the other hand, Kelchtermans and Deketelaere (2016) refers to teacher identity as the insights, beliefs, commitment and motivation, agency, and professional growth of teachers. Zembylas (2015) similarly contends that the formation of a teacher's identity is based on personal aspects of emotions. Teacher identity can also be viewed as the product of maintaining self (Pennington and Richards, 2016). and Reeves (2018), however, suggest that teacher identity is not particular but multiple.

Beijaard et al. (2004) argue that teacher identity is not a fixed characteristic of a person, but is formed through a teacher's experiences. They also emphasise that teacher identity is based on the stages through which people pass. Avraamidou (2014) also asserts that teacher identity is flexible and is molded by their personal histories and social experiences. Similarly, Zembylas

(2015) emphasises that teacher identities change over time as teachers socialise and interact with the school context, curriculum, and the community surrounding the school. Similarly, Rodrigues and Mogarro (2019) contend that as the education system changes, teachers' work is reshaped, resulting in teachers working out new ways in which to position themselves to be able to respond to the changes. On that note, Zembylas (2015) asserts that the formation of teacher identities requires the participation of teachers in professional development and learning. In addition, Beijaard (2018) assert that previous school experience, ideas promoted by teacher education programmes, and ideas that teachers have that motivate them to become teachers form part of teacher identity formation.

Furthermore, Akkerman and Meijer (2011). argue that the construction of teacher identity is related to the social factors and relationships within a teacher's context. External factors, such as colleagues, institutions, and media, shape teacher identities. Samuel (2008) also maintains that the identity of teachers depends on contextual and social factors such as class, race, gender, and stage of career; this implies that teachers have diverse identities. Furthermore, Samuel (2008, p.8) emphasises that "[i]t is understood that no two teachers are identical in their experiences, personalities, training, and interpretations of their role as members of a community involved in the practice of teaching and learning." In the same vein, Beijaard et al. (2004) . point out that the role of context is major in teacher identity construction and Chen and Mensah (2018) assert that identities are constructed in a community of practice (socially) and an individual's identity is subjective to how the person is recognised in their social context. In the same vein, Parsons and Bailey (2019) suggest that the sociocultural setting influences teacher identity.

Zembylas (2003), however, outlines that teacher identity is also related to teachers' classroom experiences, thoughts, beliefs, attitudes, and emotions. Beijaard et al. (2004) argue that teachers' attitudes can be related to how they respond to educational changes. In this vein, Zembylas (2015) contends that teacher identity can be viewed as the viewpoint that teachers develop based on themselves, their students, and their learners' learning. In addition, the methods of instruction, curriculum, and school as a social institution shape teacher identity. Therefore, as Rodrigues and Mogarro (2019) assert, the changes in the education setup, require teachers to know where they stand. Thus, even in teachers' own attitudes, beliefs, and emotions, context is the major determining factor.

Moreover, Zembylas (2003) outlines that teacher identity is a social process of interpreting and re-interpreting a teacher's experiences continuously. Likewise, Akkerman and Meijer (2011).

suggest that the formation of teacher identity is an ongoing process. Zembylas (2015), however, also describes teacher identity as a product – a form of maintaining self-resemblance. Consequently, Zembylas (2015) views teacher identity as both a product and a process since it is the result of socio-cultural powers on a teacher and an ongoing process within teacher progress. Similarly, Beijaard et al. (2004). contend that teacher identity is a process-product related to a teacher's stage of development which is defined by their interaction with their social environment. This study adopted Beijaard et al. (2004) definition of teacher identity as a process-product to explore the influence of teacher identities in teaching organic chemistry in technical sciences classes.

2.3 Teacher personal and professional identity

Teachers possess both personal and professional identities, which are discussed next.

2.3.1 Teacher personal identity

According to Hanna et al. (2019), teachers' personal identities are reliant on the type of teachers they envision themselves to be. Furthermore, sciences teachers' identities are dependent on how they see themselves in science classes. In the same vein, Parsons and Bailey (2019) assert that science teachers' identities are based on their concerns about how they teach science, what their goals are, and what motivates them such as the involvement of parents in students learning. On that note, Avraamidou (2014) maintains that teachers' knowledge, conceptions, and beliefs about how they understand the nature of science affects their personal identities. Furthermore, the sense of self as a science teacher and methods of teaching science display teacher identity.

Chen and Mensah (2018) mention that the most important part of a teacher's identity is a strong connection with their subject matter. However, Day et al. (2006) emphasise that the recognition of a teacher by others matters. In addition, the development of teachers through community of practice and teacher development activities shapes personal identity. On that note, Day et al. (2006) attest that teacher identity is the interaction between teachers' experiences and the social, cultural, and institutional environments in which they interact daily.

Beijaard et al. (2004) confirm that communities play a vital role in monitoring teachers' actions. In addition, what is communicated in the society where teachers are raised influences teachers' identity. On the same note, Day et al. (2006) emphasise that the social context has much influence on the stability of a teacher's identity. Furthermore, Day et al. (2006) maintain that the stages of development a person goes through bring about a change in their identity

resulting in an unstable identity. This suggests that teacher identity is formed through individual interaction with the social environment.

Tsang (2018) stress that teachers rebuild their teacher identities after changes made by the education system. Whenever there is a change brought about by the education system, teachers always try to find new ways to commit themselves to their work which may reveal the manner in which they cope with change. Similarly, Menon (2020) emphasise that the teacher's role and a teacher's real self, defines their identity most. Nevertheless, Tsang (2018) contend that teachers interpret their identity based on their lives. In the same vein, Menon (2020) assert that personal identity influences the determination that teachers put into their working lives and the way they view professional development programmes. Consequently, Ghanizadeh and Ostad (2016) suggest that only when teachers can balance their personal lives with work, can they work on evolving their professional identities.

Yazan (2018) argues that the way teachers make decisions and the manner they learn depends on how they perceive themselves as teachers in the teaching profession. Correspondingly, Clandinin (2019) contend that teachers do not learn continually, but rather through interacting with other teachers. In addition, individuals only choose to adopt instructional practices that are convenient to them. As a result, Yazan (2018) contends that all aspects of teachers' teaching practices depend on their information, opinions, and expectations of themselves.

Craig and Curtis (2020) proclaim that teacher identity is how a teacher views him or herself. Furthermore, teachers can see themselves as educators, researchers, or professors depending on what role they want to fulfil or with whom they work. Correspondingly Olsen (2016) asserts that a teacher's identity is a study of self but this identity should be understood in connection with the context of practice. In addition, a teacher's identity is shaped by social and cultural dimensions. On that note, Craig and Curtis (2020) emphasise that teacher training or preparation influences a teacher's identity. Teachers learn to be critical of their work since different faculties train teachers according to the type of teachers they want to produce. Such training leads teachers to see themselves according to the teacher they have been produced to be.

Avraamidou (2014) contends that science teachers see themselves as science teachers if they have scientific knowledge that they can teach students, they understand the nature of science, and they have knowledge about the science curriculum. In addition, Saraj (2017) argues that the identity of science teachers affects their confidence in teaching sciences, especially in their

first year. Saraj (2017) suggests that teacher's scientific knowledge influence their pedagogical content knowledge and experiences within the learning context. However, there is still a gap in research based on examining the scientific background of preservice teachers. Since teacher identity is a developing construct, there is a need for research to focus on how scientific background knowledge is developed to boost the confidence of preservice teachers. Kayi-Aydar (2019) argues that a teacher's identity affects teacher development by enabling teachers to remark on their influence and interaction with peers or colleagues.

Rushton and Reiss (2020) assert that the sense of self of an individual is explained through the social context. In addition, what teachers have internalised from the social context where they have been raised and matured has more of an influence on their teacher identities than their internal characteristics. Furthermore, the internalised social identity shapes who teachers think they are, how they react to teaching, and the decisions they make (Rushton & Reiss, 2020). Similarly, Avraamidou (2014) asserts that science teacher identity is central and based upon teaching the content and analysing learners' work within the teaching context.

In the same vein, Chung-Parsons and Bailey (2019) contend that the development of teacher identity and the changes in teacher identity are due to the interrelationship between personal life story and capabilities and professional familiarity which is always linked to background, learners, subject matter, and school culture and norms. Badia and Silvia (2019) argue that subject matter is one of the key models in the identification of teacher identity.

2.3.2 Teacher professional identity

Beijaard et al. (2004) affirm that while most studies reveal different definitions of professional identity, others do not define it at all. Syah et al. (2022) suggest that the challenge in defining professional identity is due to the difficulty of clarifying the meaning of identity and its dynamic nature. Zhu et al. (2020, p.5) define a teacher's professional identity as teachers' different ways of deliberate undertaking and focusing on modifying the professional landscape. On the other hand, Syah et al. (2022) define teacher professional identity as the roles of teachers in the teaching profession. Congruently, Olsen (2016) defines teacher professional identity as a study of self which is shaped by the cultural and social interactions in the profession. In the same vein, Zhu et al. (2020) claim that professional identities display the status of teachers as they are practising teaching, that is, how they see themselves and who they are in the teaching profession.

Syah et al. (2022) corroborate that there is much research on professional identity, however, most studies on professional identity examine the formation of professional identity and factors influencing professional identity (social context). In the same vein, Beijaard et al. (2004) and Rodrigues and Mogarro (2019) assert that the focus of research is on how pre-service teachers see themselves as novice teachers in the classroom, and their beliefs in terms of pedagogical content knowledge, subject matter, and their role as a teacher. However, Syah et al. (2022) contend that the studies on teacher professional identity should be based more on professionalism.

Context has been identified as one of the key external factors that influence a teacher's professional identity (Ó Gallchóir, O'Flaherty, and Hinchion (2018); Beijaard et al., 2004; Timoštšuk & Ugaste, 2010). The context that influences identity construction includes the site and learning context as well as the socio-political context. On the other hand, Gholami et al. (2021) argue that emotions, self-efficacy, conceptions of work, knowledge, and passions serve as internal factors that influence a teacher's professional identity. Thus, Beijaard et al. (2004) . assert that a teacher's professional identity is an ongoing process of negotiation between individual and contextual factors. Similarly, Syah et al. (2022) maintain that there are external and internal factors that influence a teacher's professional identity.

Gholami et al. (2021) maintain, however, that there is limited research that examines how teachers' positioning relative to the intersection of multiple opposing discourses plays out in their establishment of identity as a professional and in their professional practice. On that note, more emphasis is on classroom teaching experiences which are viewed as a key factor indicating the framework in which teachers can situate their professional choices and identity. In addition, Syah et al. (2022) assert that a teacher's professional identity integrates their experiences as a student, classroom practices or practical experiences, and research that is done based on their professional identity.

This study focused on exploring teacher identity and how it influences teaching organic chemistry in technical sciences classes. Day et al. (2006) argue that teacher professional identity is essential to understanding teacher performance and encouraging teacher obligations and maintenance of self. Gu and Day's (2007) framework on the dimensions of teacher identity underpinned this study because examining a teacher's professional identity helped to understand the effectiveness of teachers. In addition, teachers that were interviewed were from

different schools, with different norms. Thus, teachers' professional identities were understood according to their diverse social contexts.

Zhu et al. (2020) explain that a teacher's professional identity is shaped before they start education programmes. In addition, as student teachers are trained in university, they engage with different academic or non-academic programmes which reconstruct their professional identities. According to Zhu et al. (2020), student teachers learn what is expected from them as teachers from universities. Zhu et al. (2020) further explain that as student teachers engage in teaching practice, they have mentors allocated to them who monitor their teaching and display the expectations of teachers to them.

Zhu et al. (2020) assert that throughout the student-teaching period, student-teachers encounter four professional identity changes:

1. *Confirmation or consolidation*: this change is where the student teacher perceives a congruence between their background knowledge regarding the roles of teachers and the roles they encounter as they start teaching. This change is due to students getting a better understanding of their roles and responsibilities after being monitored in student teaching by a teacher. In addition, students become aware of their responsibilities and confirm their responsibilities. Syah et al. (2022) suggests that as a student teacher starts to engage in classroom activities, their professional identity is formed.

2. *Elaboration or expansiveness*: this change occurs when student teachers start to develop an understanding of their professional identity as they continue teaching. At this stage, student teachers compare their different pre-existing professional identities which were shaped through mentoring with what they learn as they teach. Syah et al. (2022) emphasise that as student teachers begin teaching practice, they instill distinctions obtained from theories and relate them to what they learn from the field. In this stage, student teachers understand their professional identities by also elaborating on how contextual factors affect their existing knowledge. The expansion of a teacher's professional identity is shaped by the teacher's experiences with colleagues, relationships with other agencies, and personal and institutional problems.

3. *Contradiction or disequilibrium*: in this stage, the contradictions in a teacher's professional identity are due to their newly formed professional identity. At this point,

the teacher has to reject some of their prior identities or beliefs to accommodate newly perceived teacher roles. The modification of a teacher's professional identity causes an internal contradiction between prior knowledge and new knowledge.

4. *Stability or minor change:* the minor change in the professional identity displayed by a teacher might not be obvious from the beginning to the end of teaching. Teachers communicate their prior professional identity with the perceived professional identity through teaching. Teachers stabilise the minor change with previous knowledge to shape their professional identities. Day et al. (2006) highlight that the structures that contributes to the stability and positivity of teacher identity varies at different levels (macro, meso, and micro).

Zhu et al. (2020) emphasise that teacher educators need to make an effort in mentoring novice teachers to adjust their practice. Similarly, Kayi-Aydar (2019) asserts that all teachers were once students, and the interaction between teachers and peers or colleagues enhances the development of their teacher professional identities. In the same vein, Kessler (2021) contends that professional identity is created through what a teacher imagines for the future and the experiences they have during the teaching process. As a result, Ghanizadeh and Ostad (2016) argue that professional advancement and a teacher's awareness of change are shaped by their professional identity.

2.4 Teacher emotions

Chen and Mensah (2018) argue that emotions are viewed as difficult and complex, and not easy to define or understand. Multiple definitions for emotions have been offered. For example, Thomas et al. (2016) define teacher emotions as feelings that embrace cognitive, physiological, motivational, and expressive components. Similarly, Keller et al. (2014, p.69) define emotions as "psychological processes, including emotion-specific motivational tendencies, expressive behaviors, and physiological processes and cognitions". In the same vein, Frenzel et al. (2021, p.251) define "emotions as the interface between an individual and their environment, continually mediating between events and social contexts and the individual's responses and experiences". On the other hand, Zembylas (2005) defines emotions as a broad practice in which individuals involve themselves in a multifarious network of power relations. Nevertheless, Thomas et al. (2016) contend that teacher emotions are accompanied by specific thoughts and Zembylas (2003) contends that emotion is inextricably linked to teachers' lives.

Several scholars emphasise the role of the social environment in emotions. Chen et al. (2020), for example, assert that emotions are contracted in a social context, and personally endorsed. Similarly, Killer et al. (2014) contend that emotions are general, purposeful reactions to an exterior incitement event. In the same vein, Frenzel, Goetz, and Stockinger (2024)contend that emotions are socially constructed and personally enacted through conscious and unconscious judgments to achieve goals. According to Becker et al. (2014), emotions are transferred directly or indirectly from one person to another. Similarly, Keller et al. (2014) suggest that emotions shape how one responds to a current situation. In accordance, Keller et al. (2014) emphasise that teacher emotion is defined by the environment. As a result, Becker et al. (2014) assert that learners' and teachers' emotions are interconnected. Therefore, Chen et al. (2020) maintain that principles used by teachers to make decisions are guided by their emotions.

On the other hand, Hargreaves (1998) asserts that emotions are individual and mindful feelings that usually evoke certain occurring responses or reactions from an individual to a particular event. Nevertheless, Hargreaves (1998, p.2) emphasises that emotions are the "heart of teaching". According to Thomas et al. (2016), the emotions of teachers are considered to be relevant not only to teacher well-being but also to how teachers function in the classroom. Similarly, Becker et al. (2014) contend that emotions are vital since they ensure personal well-being, and influence learning strategies and teaching outcomes, including academic achievement. In the same vein, Becker et al. (2014) suggest that a teacher's emotions influence the teacher's instructional behaviour which is important for learners' emotions. Congruently, Frenzel et al. (2021) mention that teachers' behaviour and classroom practices influence students' behaviour, which develops teachers' emotions. As a result, Becker et al. (2014) opine that teacher emotions play a vital role in the teaching profession for both teachers and learners. Rodgers and Scott (2008) also assert that the emotional domain of teachers is very important.

Hargreaves (2001) and Lasky (2000) examined the role of emotions in education. Despite this, Thomas et al. (2016) maintain that there is little research done on narratives of teacher's emotions. However, although Wu and Chen (2017) confirm that years ago scholars ignored the aspect of teacher emotions in academics, Chen (2016) claims that most research fields of teaching have shown less interest in rational factors such as teacher knowledge, abilities, and capacities, and more in teacher and learner emotions. Furthermore, Rodgers and Scott (2008) highlight that studies on teacher wellbeing tend to focus on the positive factors that support and enhance teacher well-being rather than any negative consequences that may have an impact on

teachers' well-being. In the same vein, Theron (2016) contend that such studies have looked at the factors that support teachers' resilience and their ability to develop their strengths.

Wu and Chen (2017), however, found that teachers possess negative and positive emotions in teaching simultaneously. They concur with Thomas et al. (2016) that teachers experience various emotions such as enjoyment, anger, and anxiety. Furthermore, the high frequency of teacher emotions, both positive and negative, mostly comes from teachers' interactions with students, colleagues, parents, and education reforms. Thus, Thomas et al. (2016) argue that emotions not only influence teaching quality but also the bond between teachers and learners. In addition, Frenzel et al. (2021) highlight that positive teacher emotions relate to desirable outcomes and negative emotions to undesirable outcomes, and that learner outcomes also influence teacher emotions. Therefore, Keller et al. (2014) argue that good teaching is the result of positive emotions. Moreover, Chen (2016) asserts that teachers develop positive emotions if they can serve their purpose, are satisfied with their job, and have close relationships with their learners. Similarly, Corcoran and O'Flaherty (2018) maintain that positive emotions are the results of positive experiences regarding teachers' relationships with learners, while Kern et al. (2014) assert that positive teacher emotions are developed by learners' behaviour, academic growth, and achievement.

On the other hand, Wu and Chen (2017) assert that negative interactions between learners and teachers result in teachers having stress. Congruently, Wu and Chen (2017) maintain that learners' misbehaviour is recognised as a source of negative teacher feelings. Correspondingly, Keller et al. (2014) contend that teachers experience negative emotions such as anxiety and anger. Chen (2016) maintains that teachers develop negative emotions if they are mistreated, their work lives are not stable, or when they experience pressure from schools or the context outside the school environment. Similarly, Kern et al. (2014) suggest that teachers can develop negative emotions due to experiences outside the classroom, the school infrastructure, and the pressure from the education system. Lasky (2000) contends that teachers also experience negative emotions if they fail to serve the purpose of their profession due to the destruction caused by negative learner-teacher relationships. According to Keller et al. (2014), negative teacher emotions can lead to teacher burnout.

2.5 Technical sciences as a subject

Donilina (2020) contends that the introduction of technical sciences as a subject was one of the ways to overcome unemployment, poverty, and social injustice to improve society. DBE (2011)

outlines that the main aim of introducing technical sciences was to support learners in three areas of technology, namely, mechanical technology, electrical technology, and civil technology. In addition, learners gather these skills from technical high schools to enable them to address the needs of these industries and promote technology in schools.

Bonnett (2019) asserts that the education system uses science and technology as a background to help learners to figure out that science and technology are innovative human careers with a rich cultural history. Moreover, Bonnett (2019) contends that science is a method for understanding the universe. Investigation, reflection, imitation of practical activities, analysis of data, and discussions of interpretations of data all contribute to this learning. Furthermore, predicting, analysing, and explaining both natural and man-made occurrences are part of the scientific process. There is now much debate among historians, sociologists, and philosophers of science on the existence of a defined, universal process for performing scientific research. Instead, they view science as being influenced by a diversity of hypothetical issues, facts, experiments, and procedures rooted in reality.

Furthermore, Huang (2010) outlines that scientific investigation is a way of learning about the world. It involves questioning and searching for clarifications of occurrences. There are a variety of scientific methods that can be used by learners to acquire skills to conduct different types of experiments. Skills such as inquiring, observing, gaging, assuming, categorising, planning experiments, and gathering, evaluating, and deducing data are essential to scientific inquiry as are approaches such as interest, uncertainty, and creativity. These skills are often represented as a sequence which involves posing questions, producing likely clarifications, and gathering and examining data to determine which explanation is most accurate for the occurrences under inquiry (DBE, 2011). It is noted, however, that most scientific inquiries (past and present) do not automatically follow a set sequence of steps, nor do they always start at the "foundation" of the cycle; scientists can be creative and responsive to scientific tests as they arise.

DBE (2011) outlines the following skills that learners acquire through studying technical sciences:

- Classifying
- Communicating
- Measuring
- Designing an investigation

- Drawing and evaluating the conclusion
- Formulating models
- Hypothesising, identifying, observing, and comparing.
- Interpreting and predicting
- Problem-solving and reflecting

With these skills, attained from technical sciences, learners are prepared for further education training, employment, citizenship, holistic development, and socio-economic development (DBE, 2011). Furthermore, Donilina (2020) claims that with learner development through technical sciences, social well-being and justice are promoted while poverty and unemployment are overcome (Donilina, 2020). DBE (2011) also describes six main knowledge areas that need to be covered by technical sciences teachers, namely, mechanics, matter and materials, electricity and magnetism, waves, sound and light, heat and thermodynamics, and chemical change. In addition, the most important part of technical sciences is the practical work which should be connected with theory to strengthen the concepts being taught.

As a result of the nature of technical sciences and the skills that need to be acquired by students, teachers are required to remain updated on better professional practices and content areas for industry needs (Cannon et al., 2010). In addition, teachers need to be up-to-date with new changes in the curriculum so that they are be able to apply corresponding methods and have technology updates to help students acquire skills effectively.

Creativity plays a vital role in teaching and learning technical sciences. Diyora and Kiramidinouna (2023) contend that the development of creativity skills in learners helps them to transform basic knowledge into scientific knowledge. Furthermore, learners' creativity helps them to implement theory taught into practice. Diyora and Kiramidinouna (2023) also suggest that the content taught should be practical, which can be achieved through applying technology in the form of models and implementation.Lin and Wu (2016) argue that for creativity skills to be developed, the following conditions should be met:

- Each model of the lesson should promote the development and formation of a certain skill aligned with the educational area.
- General scientific, professional, and specific knowledge and skills need to be grown.
- Theoretical knowledge needs to be transferred to practical activities.
- The pedagogical approach used should involve the external environment, motivation, content, and usage of effective components.

The above-mentioned conditions show that effective teaching of technical sciences depends on the level of teacher knowledge, level of mastery, and source of education (Cannon et al., 2010). However,Lin and Wu (2016)assert that education stakeholders and schooling support sometimes lack funds to support teachers with the needed equipment to enable them to teach effectively, so teachers struggle and fail to develop the required skills in learners. For this reason, it is vital to provide teachers with the necessary resources to conduct practical activities so that learners can effectively be prepared for global employment demands.

2.6 Effective teaching of organic chemistry

According to Ismaili (2021), to understand how learners learn chemistry, one should consider learners' manner of thinking, learning experiences, and the school context. In the same vein, Swackhamer et al. (2006) assert that teachers who work with learners' prior understanding and those who understand learners' science background are effective in their teaching. In addition, Caleon et al. (2018) argue that effective chemistry education should incite and involve learners, as well as reply practically to learner understanding. Furthermore, effective teachers are monitors of learner understanding, thinking, and contribution.

Saleme et al. (2020) claim that organic chemistry is required as a basic passage to most science majors such as engineering and health fields; however, with the demanding workload that learners have to cover, they end up failing organic chemistry. Furthermore, Ananda et al. (2023) contend that learners find it difficult to transfer their prior chemistry knowledge to organic chemistry. On the other hand, Srivastava et al. (2021) maintains that the use of concept maps is most effective for learners to achieve in organic chemistry. In addition, Singh et al. (2021) assert that organic chemistry equips learners with skills, knowledge, and attitudes that encourage them to understand the environment and solve problems in society. To be more precise, Gibbons and Raker (2019) argue that organic chemistry requires learners to solve problems through algorithmic thinking, however, learners find this thinking challenging since it requires deep content knowledge.

According to Saleme et al. (2020), organic chemistry is one of the topics that learners find most difficult to learn; and the section on synthesis in organic chemistry is particularly challenging. They elaborate that the rules and chemical reactions in the synthesis section make organic chemistry difficult. Luhao and Jiaying (2023) argue that the major problem is that learners can use different ways to solve the synthesis problems. Similarly, Srivastava et al. (2021) contends

that learners find it difficult to understand concepts and master the many reactions; and that learners have a negative attitude toward learning organic chemistry. On that note, Dwyer (2017) outlines various factors, such as learners' understanding of concepts, methods used by teachers, and poor learner enthusiasm and engagement in learning that lead to learners experiencing difficulty with learning organic chemistry.

Furthermore, according to Ojima (2017), organic chemistry has many subtopics that need to be covered, including concepts such as functional groups, reactions, and problem-solving. Dwyer (2017) outlines the three components of organic chemistry, namely, the macroscopic part, which refers to what can be seen, the sub-microscopic or invisible part, and the symbolic part, which involves the chemical symbols and reactions. In addition, Ramakrishna (2020) argues that the vocabulary and concepts taught in organic chemistry are new to learners. This leads to learners feeling overwhelmed by the large amount of content that needs to be covered

According to DBE (2011), teaching organic chemistry not only benefits learners in solving societal issues, but it also improves the economy. In the same vein, Srivastava et al. (2021) contends that organic chemistry focuses on the manufacturing and processing of organic substances, such as petroleum and many other synthetic substances. This highlights the importance of teachers using effective teaching methods to help learners master organic chemistry (Saleme et al., 2020). According to Hanson (2017), practical activities are vital since they increase learners' understanding. Similarly, Gibbons and Raker (2019) assert that practical activities allow learners to engage actively in learning and increase learners' enjoyment of learning organic chemistry.

However, Hanson (2017) argues that some schools experience challenges with conducting practical activities because they lack equipment and science materials. Barroso-Osuna et al. (2019)agree that science materials are very costly, and as the number of learners doing science increases, this adds to the problem. As a consequence, Kusmawan (2023) found that, while some teachers use virtual labs, other teachers do not do practical activities and focus more on theory. Srivastava et al. (2021), however, contends that teachers who focus on theory make it difficult for learners who become passive in their learning and end up failing their examination.

Saleme et al. (2020) proclaim that how teachers respond to learners' thinking depends on what they remark about that thinking, and on what they interpret to be the strengths and weaknesses of the learners' understandings and approaches. Correspondingly, Tufail and Mahmood (2020) contend that effective teachers frequently gather information from different sources to give

their learners feedback on activities done in the classroom. In the same vein, Ananda et al. (2023) note that teachers test their learners' thinking by giving them homework, classwork, and even tests and experiments. Correspondingly, Singh et al. (2021) argue that, for teachers to attain a new understanding of learners' reasoning, they should use instructional approaches and assessments that are familiar to learners.

Lawrie et al. (2019) assert that teachers teaching chemistry have high content knowledge of organic chemistry. Nevertheless, Dwyer (2017) suggests that teachers are unaware of how to resolve the internal and external factors that affect their teaching. Black and Deci (2000) indicate that the motives for learning organic chemistry come from instructors' support and autonomy. Furthermore, if the teacher is supportive of learners, learners increase their self-regulation and interest in learning organic chemistry.

Thus, Gibbons and Raker (2019) contend that teacher emotions contribute to academic success because they influence the enthusiasm of learners to learn new content. In the same vein, Black and Deci (2000) argue that learners with a high interest in learning have a high chance of not dropping out of the course. Furthermore, the three-dimensional thinking that is required in solving organic chemistry can be easy if learners enjoy and have no anxiety about solving organic chemistry problems. As a consequence, Gibbons and Raker (2019) maintain that, since organic chemistry has new vocabulary and requires problem-solving algorithms, teachers need to engage learners in learning and support them to improve their performance.

2.7 Conceptual framework

This study adopted Gu and Day's (2007) dimensions of teacher identity and Hargreaves's (2001) emotional geographies of teaching as the conceptual framework. This section outlines the three dimensions of teacher identity and five emotional geographies which were used to analyse and interpret the research questions.

2.7.1 Three dimensions of teacher identity

Gu and Day (2007) draw on socio-cultural theory to outline three dynamic dimensions as a framework to understand teacher identities, namely, the personal, professional, and situated dimensions. According to Gu and Day (2007), teachers' lives interact with their work or career of teaching. The capacity of teachers to continue to recover and manage their own lives as well as the context are viewed as vital conditions and as contributing factors in the effectiveness of teachers to produce quality work.

Teachers in their workplaces overcome ever-changing circumstances that affect their identities. Gu and Day (2007) argue that resilience expressed by teachers differs from person to person. This is due to individual experiences which vary according to what each person comes across and how they manage their challenges. Furthermore, teacher resilience is not commonly constructed, rather it is determined by a teacher's interaction with the external environment where they are situated. Within each dimension, teachers' experiences vary, and this affects their identities. A change in one of the dimensions affects the other dimensions resulting in a teacher's identity being unstable. Consequently, Gu and Day (2007) argue that teachers' resilience and effectiveness are measured by how well teachers manage the interactions among the three dimensions.

Gu and Day (2007) assert that the professional dimension describes teachers' social viewpoint. This dimension includes the changes made in the teaching profession by the Department of Education, the exposure of teachers to the ever-changing curriculum, as well as the way teachers respond to and implement the new curriculum. Furthermore, the professional dimension is considered as a teacher's ideas that shape their implemented strategies in the classroom. Day et al. (2006) argue that the teaching profession places high demands on teachers because the workload is ever-changing. Therefore, whenever teachers feel they do not meet what is expected of them, they find themselves not satisfied with their job. This reflects the professional dimension of teacher identity.

According to Gu and Day (2007), the situated dimension of teacher identity is located within the school context, which refers to the school environment and the situations that take place. Furthermore, students and school leadership form part of the situated dimension. Similarly, Day (2013) claims that when leadership, relationships with colleagues, and support are positive, teachers' commitment and passion remain stable. If there is any opposition in the school context, however, teachers become demotivated and lose their eagerness to work effectively.

Finally, Gu and Day (2007) contend that the personal dimension refers to teachers' lives outside the school context. The lives of teachers outside the school environment affect the way teachers manage their challenges within the school. Gu and Day (2007) argue that the occurrences in a teacher's personal life influence the way they deliver their lessons and the way they respond to the changes that take place within the classroom. Furthermore, Gu and Day (2007) suggest that the behaviour of teachers in the classroom is influenced by their beliefs and principles.

Gu and Day (2007) assert that these three dimensions of teacher identity change throughout teaching and need to be managed. In order for teachers to be effective and committed to their work, they need to maintain a balance within these dimensions. This suggests that these three dimensions of teacher identity connect and influence one another. Day et al. (2006) argue that if teachers are positive they manifest positive professionalism which results in effective work.

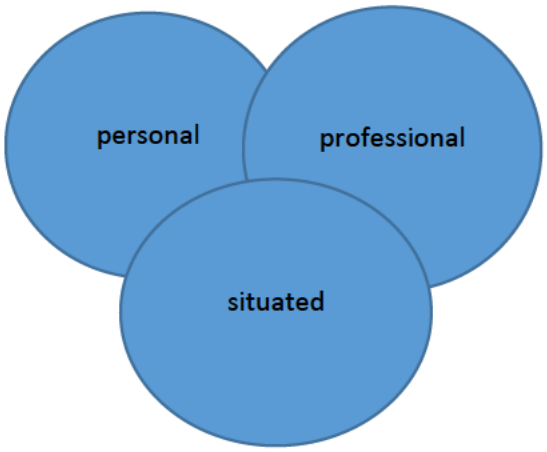

Figure 0.1 - Dimensions of teacher identity in balance (Source: Day et al., 2006, p. 151).

According to Gu and Day (2007), teachers are effective when the personal, professional, and situated dimensions are balanced. They add that any fluctuation in one dimension should be managed since the dimensions are interconnected. Moreover, for teachers to be satisfied with their job, the personal, situated, and professional dimensions of their identity need to be balanced. In this study, this framework was used to understand and analyse research question one which examined the personal and professional identities of teachers teaching organic chemistry topics in grade 12 technical sciences.

Gu and Day (2007) contend that if teachers experience a positive or stable personal life, their ability to manage professional problems increases. However, if a close relative of a teacher is sick or dies, then the teacher could be devastated which negatively influences his or her resilience. Consequently, the teacher may fail to deal with challenges at work. The same applies to the situated dimension; suggesting that if a teacher does not have a good relationship with their colleagues, this influences the teacher's management of curriculum changes. Therefore, the capacity of teachers' resilience is measured by the three dimensions of their identity, which are dynamic and interconnected.

2.7.2 Five emotional geographies

Hargreaves (2001) contends that teaching is not only concerned with delivering lessons, understanding, abilities, and knowledge but also involves teacher emotions, which are the result of teachers' experiences. In addition, emotions develop through interacting with learners, colleagues, and parents. Hargreaves (2001) suggests that teachers experience a range of emotions such as boredom, commitment, frustration, and enthusiasm.

The framework of emotional geographies serves as a way to understand the combination of distance and closeness that affects the emotions of teachers which yield to high standards of teaching and learning. Since emotions are part of teaching, it is vital to understand why emotions are organised in a specific way in the dynamic life of the school as an organisation.

Hargreaves (2001) outlines five emotional geographies that describe the patterns of closeness and distance in the human interaction of teaching which determine teachers' emotions after interacting with other people. Hargreaves (2001) elaborates on sociocultural distance, moral distance, professional distance, physical distance, and political distance. Understanding such aspects of these emotional geographies assists in understanding how teachers experience positive emotions through having good relationships with learners, colleagues, parents, and others, as well as producing knowledge about how to reduce negative emotions.

Hargreaves (2001) outlines that sociocultural distance refers to teachers being aware of the diversity of learners in their classrooms. Classrooms consist of learners from different cultures and classes, such as lower, middle- and upper-class backgrounds. Thus, teachers find themselves teaching learners from different backgrounds, which may not be familiar to teachers. Hargreaves (2001) asserts that the sociocultural distance results in teachers being stereotyped by the communities they serve. In addition, if teachers are aware of the culture and norms of the community to which their learners belong, it becomes easier for them to understand learners and develop relationships with their parents. Furthermore, teachers build better emotional understanding with parents and learners if they have cultural knowledge and can deal effectively with parents' behaviours and attitudes toward their learners' education.

Hargreaves (2001) outlines emotions as a moral phenomenon. The interaction between teachers and parents activates teachers' morale. Hargreaves (2001) points out that closeness and support given by parents, administrators, colleagues, and learners develop positive emotions in teachers. If teachers distance themselves from others, the purpose of teaching becomes lost, which results in negative morals. In addition, when parents are not at a distance and appreciate

teachers' effort and work, the emotions of teachers become more positive. Moreover, teachers become enthusiastic and motivated, which enhances their creativity in teaching.

Hargreaves (2001) outlines the professional distance between parents and teachers as one of the critical aspects of effective teaching, and suggests that teachers' emotions should always be based on curriculum activities and performance of students. Therefore, Hargreaves (2001) strongly believes that the professional distance should be formal, and the interaction between teachers and learners and their parents should be managed in a professional way. In addition, communication and manner of approach should be professional and based on work. Teachers need to keep their professional autonomy so that parents do not take advantage of them, and they are protected.

Physical distance refers to the occasional contact between teachers and parents or non-face-to-face communication which is needed to construct emotional understanding and a partnership between teachers and parents (Hargreaves, 2001). The physical closeness of a teacher to a parent creates a bond between them, which results in positive emotions. However, Hargreaves (2001) points out that physical closeness and frequent interactions sometimes result in fights and obstructions between teachers and parents. Therefore, teachers should always ensure that interactions are professional.

Finally, Hargreaves (2001) asserts that emotions are the result of teachers' experiences of power or powerlessness. In addition, teaching is surrounded by emotional politics, and as a result, teachers experience various emotions through working under the authority of those in power. Political distance intimidates physically close people. Consequently, if the relationship between teachers and parents is denoted by power, not partnership, then negative emotions arise. However, if teachers wish to put parents professionally at a distance, in some instances, powerful parents find a way to get physically closer to teachers (Hargreaves, 2001). With political distance, those who are politically superior will always have power over others.

To sum up, the five emotional geographies are based on having better emotional understanding which influences the quality of education (Hargreaves, 2001). Therefore, in all their interactions, all parties should show a willingness to collaborate with one another; and, above all, they should have one purpose, which is to benefit learners' education. In this study, this framework was used to understand and analyse research questions two and three, which examined teachers' emotions about teaching organic chemistry in grade 12 technical sciences classes.

2.8 Conclusion

This chapter presented an overview of teachers' personal and professional identities as well as the conceptual framework adopted by this study. The chapter commenced with an outline of various definitions of teacher identity from different scholars. Next, teacher personal and professional identity were discussed as well as the different factors that influence teachers' personal and professional identities. The literature highlights that teachers experience mixed emotions when teaching, which influence classroom practices and learner performance. Thereafter, technical sciences as a subject was discussed, and the rationale for introducing technical sciences was outlined. Next, the literature on teaching organic chemistry was discussed.

The chapter concluded with an outline of Gu and Day's (2007) professional, situated, and personal dimensions of teacher identity followed by a discussion of the five emotional geographies by Hargreaves (2001). This framework underpinned this research study and data analysis process. The next chapter describes the research methodology and design employed in this study.

Chapter 3

Research Design and Methodology

3.1 Introduction

The previous chapter outlined the literature review of relevant research, as well as the conceptual framework employed in this study. This study aimed to explore the identities and emotions of teachers teaching organic chemistry in technical sciences grade 12 classes in the Harry Gwala and Ugu districts. It further examined how teacher identities and emotions influence the teaching of organic chemistry in technical sciences grade 12 classes.

This chapter outlines the research design and methodology that was used to generate and interpret data to understand teacher identities and emotions and how these influence the teaching of organic chemistry in technical sciences. This chapter begins with a discussion of the interpretive research paradigm and the qualitative methodological approach. This is followed by the description of the narrative inquiry research design. Thereafter, the methods of data generation that were employed in this study are discussed, namely, collages and semi-structured interviews. Next, the research context, purposive sampling technique, and procedures are discussed, followed by a discussion of the data analysis procedure. The chapter concludes with an outline of the ethical considerations and trustworthiness of this study. The research design and methodology were guided by the following research questions:

1. What do grade 12 technical sciences teachers' stories tell us about their personal and professional identities and their teaching of organic chemistry?
2. What emotions do grade 12 technical sciences teachers experience when teaching organic chemistry?
3. How do grade 12 technical sciences teachers' emotions influence their teaching of organic chemistry?

Research design

Eakin and Gladstone (2020) defines the research design as a plan that is used by a researcher to assist in generating and analysing data that is needed to address the research questions. Ruane (2016) describes the research methodology as how the research study is conducted scientifically and locates the types of research designs and research methods that are engaged to generate data. According to Eakin and Gladstone (2020), the research methodology is very

important in the research process because it is a window through which a researcher looks when trying to decide on acquiring data about social occurrences and getting answers to the research questions.

3.3 Interpretive research paradigm

According to Thanh and Thanh (2015) and Mokhtar (2022), different scholars understand and define paradigms differently. Mertens (2021) describes a research paradigm as a mechanism to discover how one describes or interprets the world. This study was positioned within the interpretative paradigm. According to López-Alvarado (2017), the interpretive paradigm seeks to understand by discovering an individual's views. In addition, reality is viewed as independent and every participant has their own generalisations that varies from others'. According to Cohen et al. (2017, p.21), the interpretive paradigm mainly aims to recognise personal experiences. Interpretivists strongly believe in the idea that many realities exist, and that each reality has its own interpretation and perception (Maree, 2020). Humans create meaning by conveying an independent understanding of lived experiences. Thus, Thanh and Thanh (2015) and Mokhtar (2022) contend that the interpretive approach is best suited to produce qualitative data. Therefore, there is an interrelation between the qualitative methodological approach and the interpretive paradigm.

Thanh and Thanh (2015) and Mokhtar (2022) further assert that the interpretive paradigm allows the researcher to get in-depth information. Moreover, the researcher uses the experiences of participants to interpret and construct an understanding of the gathered data. Creswell (2017) argues that the interpretive paradigm discovers reality through understanding the participants' views which are based on their backgrounds and experiences.

This study was located within the interpretive paradigm because it aimed to get insight into the experiences of grade 12 technical sciences teachers in teaching organic chemistry. Furthermore, this study aimed to explore teachers' identities and emotions in teaching organic chemistry in grade 12 technical sciences classes. As the researcher, I embarked on a search of the social circumstances of the teaching environment and aimed to understand the influence of teachers' identities and emotions on their teaching. According to Cohen et al. (2017), emotions are constructed through interactions with the context (personal, professional, or social). Thus, the interpretive paradigm best fits the study because it allows the researcher to understand teachers' feelings and the meanings of their lived experiences to understand their behaviours (Carter & Pulla, 2018). Through the interpretive paradigm, I was able to develop an in-depth

understanding of the participants' lives. Since teacher identities are socially constructed and dynamic, the interpretive paradigm was effective to gather data on teacher identities. Thanh and Thanh (2015) and Mokhtar (2022) emphasise that interpretivist researchers believe that reality is socially constructed, therefore the context where data is gathered needs to be understood and explained as such.

3.4 Qualitative approach

Basias and Pollalis (2018) define qualitative research as a series of interpretive techniques that seek to describe, write, and translate concepts and phenomena. Similarly, Merriam (2009) asserts that qualitative research is the approach that deals with the phenomenon by analysing the experiences, behaviours, and relations of participants while considering textual data. Merriam (2009) contends that when researchers choose to use qualitative methods, their interest is mainly in understanding how people view and interpret their experiences and how they construct their world and give meaning to their experiences. Furthermore, the data generated through a qualitative approach is believed to be socially constructed.

According to Merriam (2009), qualitative research is underpinned by constructivism and symbolic interactions. Taylor (2017) maintains that constructivism allows individuals to be actively involved in the development of a phenomenon. asserts that participants are the active constructors of their world. Nevertheless, Merriam (2009) contends that researchers have their own beliefs and opinions which should not interfere when they interpret participants' behaviours as participants are situated in different contexts that influence their behaviours. Merriam (2009) notes that each person's behaviour is based on how they interpret reality or the world through their experiences.

The qualitative methodology is the approach that mainly focuses on understanding occurrences. Accordingly, contend that researchers who choose qualitative methods seek to understand a phenomenon through conducting in-depth research in which participants' experiences are the foundation. The focus of qualitative research is based on how participants react to what they encounter in their daily lives. Merriam (2009) suggests that qualitative studies survey particular capabilities of people and how they derive in-depth meaning from them. This description of the qualitative approach reveals it as appropriate for this study since teachers' identities and emotions were investigated to explore their behaviour and, as Merriam (2009) notes, behaviour is based on how individuals interpret reality or the world through their experiences.

Creswell (2017) maintains that qualitative research has been used when the individual's stories and their voice are heard and empowered. Furthermore, the empowerment of individual stories and voice is always understood within the context of the individual, the personal and professional context. Beijuard et al. (2004) contend that teacher identities are socially constructed and are described by individual interactions within the context. Thus, the qualitative approach, as bounded to symbolic interactions, was suitable for this study because I was able to understand how teachers make sense of their teaching through their experiences within their context.

The study aimed to explore how teacher identities and emotions influence their teaching of organic chemistry in technical sciences classes. Teacher professional learning and teaching are influenced by different factors, such as teacher attitudes, working environments, and contextual factors which are entwined with their personal lives and emotions (Zembylas, 2003). The general purposes of qualitative research are based on understanding how people make sense of their world through the manner they interpret their experiences and make meaning. This aligned with the aims of this study making it an appropriate approach to use.

3.5 Narrative research

Narrative research is one of the methodological approaches that is used in educational research. Clandinin and Collenelly (2000) define narrative research as a method of collecting a story about a phenomenon that you study. This is a methodological approach that is based on a series of events. Fittingly, when talking about identity, we talk of a series of meanings and a sense of belonging.

According to Polkinghorne (1988), the term narrative can be used to refer to any spoken or written expression; this can be a written essay or paragraph. In narratives, methods of writing and describing stories are constructed from analysing told stories. Polkinghorne (1988) further asserts that the narrative methodological approach is aligned with qualitative research, in which the researcher describes the lives of individuals by generating data through writing narratives of individual experiences and and uses procedures to generate data about people. Craig and Curtis (2020) suggest that narrative research explores the story of the self, privileges the self in the research design, and recognises that addressing the self can contribute to our understanding of teaching and teacher education.

Furthermore, Olivier (1998) contends that narrative inquiry uses stories to illustrate the complexities of human experience and is widely used in anthropology, sociology, and educational research. In the same vein, Nichols (2021) asserts that in narrative research the participants are considered experts and hold power as they are able and allowed to tell their own stories. Similarly, Ntinda (2018) maintains that the narrative analysis puts people at the heart of the research inquiry ensuring their voices are heard. It is critical for narrative research that the unique stories and voices of the participants are heard.

Dulal (2016), however, considers the use of narrative inquiry only appropriate for a small sample of participants because the researcher needs to work closely with participants which takes longer. Additionally, Ntinda (2018) argues that the researcher might end up not gathering all data and content that a participant can tell because of time. Furthermore, teachers can give responses that are not connected due to different experiences in different contexts. Thus, this was the limitation of using narrative inquiry in this study.

Narrative research, however, was appropriate to this study, as it is based on the idea that people have lived stories that they can tell Clandinin (2018). In the same vein, Ntinda (2018, p. 3) states that narrative inquiry is well suited to qualitative research as it gathers in-depth information to understand teacher's experiences. Narrative inquiry is based on the experiences of people and how they understand and describe aspects of their lives. Therefore, this study used a narrative research design to generate stories about teachers' identities and emotions.

In addition, according to Norton and De Costa (2018), narratives are used to construct identities and highlight complex identity positions and are therefore important when studying identity. Thus, a narrative approach allowed participants of this study to discuss how their experiences assisted the development of their identities and emotions through self-reflection. Ford (2020) contends that narrative inquiry assists one in scrutinising how to support individuals and build on recent research methods.

3.6 Data generation methods

The data generation methods that were used in this study were semi-structured interviews and collages. These two methods generated data to address the research questions.

3.6.1 Semi-structured interviews

Cohen et al. (2017, p.11) define an interview as "an interchange of views between two people conversing about a theme of mutual interest". Yin (2009), meanwhile, states that interviews

are characterised by posing and answering questions and participants' observations. DiCicco-Bloom and Crabtree (2006) describe semi-structured interviews as one of the data generation methods used in qualitative research. On that note, McIntosh and Morse (2015)contend that semi-structured interviews are underpinned by the application of qualitative research. In addition, DiCicco-Bloom and Crabtree (2006) assert that semi-structured interviews are resourceful and malleable, and can be joined with the distinct and group interview method.

These characteristics of the semi-structured interview made it suitable for me to use to generate in-depth data about the emotions of teachers when teaching organic chemistry. In addition, Gerstenblatt (2013) maintains that interviews produce verbal data. This was applicable to my study as I talked to my participants about how they feel and encouraged them to tell their stories based on the questions I asked while observing their facial expressions and body language as well. In the same vein, Mukherjee (2019) asserts that the nature of asked questions is open-ended to allow participants to talk without being limited so they will answer openly. This is a strength of semi-structured interviews because open-ended questions allow individual responses that help to explain the social phenomenon. Likewise, Kvale (1996) contends that during the interview, the interviewer and interviewee are engaged in an ongoing process of making meaning.

Kothari (2004, p.98) identified the following advantages of semi-structured interviews: a large amount of information can be attained with greater flexibility. As a result, questions can be reworded to facilitate understanding. Furthermore, Mukherjee (2019) emphasises that observation can be used while the participant is answering a particular question. As a result, information about participant' personal lives can be attained. Personal characteristics and valuable information on the environment may also be collected. Yin (2009) mentions that another strength of semi-structured interviews is that questions are open-ended, changeable, flexible, and related to the context of the study. Moreover, the questions in semi-structured interviews allow freedom to deviate considerably from the interview schedule.

Kothari (2004, p. 99) identified the following disadvantages of interviews: there is a possibility of bias arising from both interviewer and interviewee, this method consumes a lot of time, and sometimes the participant may be overstimulated by the presence of the interviewer. This might lead to the interviewee responding with information that they think is desirable. Furthermore, McIntosh and Morse (2015)suggest that the responses given by participants are sometimes not in-depth and Dokzewski (2022) mentions that the participants' responses depend on their

experiences regarding the phenomenon. However, all participants get a chance to answer the same questions, asked in the same manner.

Regarding my research study, which was based on exploring teachers' identities and emotions through semi-structured interviews, I had a chance to pose questions to my participants and observe their facial expressions while they told their stories. Gathering data through semi-structured interviews in my study was based on interacting and having probing questions to generate rich data needed for my study. This data was both verbal and non-verbal. Questions were open-ended which allowed participants to speak freely. Furthermore, as the researcher, I was able to probe and ask participants to elaborate and clarify their statements. Semi-structured interviews were used to answer the first and second research questions.

3.6.2 Collages

This study used collages to generate data. Butler-Kisber and Poldma (2010) define a collage as a data generation method that is based on artistic procedures. According to Butler-Kisber and Poldma (2010), a collage is a process of cutting and sticking or gluing images and material to a plain surface. In the same vein, Creswell (2017) contends that the collage is a mode of generating visual data that is underpinned by constructivist epistemology.

Wilson, Butler-Kisber and Poldma (2010) assert that reality is constructed or re-constructed through activities that humans engage in and their interactions with their surroundings. Therefore, Butler-Kisber and Poldma (2010) emphasise that the collage as a visual inquiry method seeks to understand phenomena by engaging participants to reveal their lived experiences and feelings. On the same note, Goba et al. (2007) maintain that collages reflect the way we see the world with objects being given meaning not from something within themselves, but rather through the way we perceive them.

Wilson, Mandich and Magalhães (2016) argue that the significance of using collages is that they reflect the participant's thoughts, insights, and how they interpret the phenomenon. Moreover, the reflections revealed by participants visually, help a researcher to have an in-depth understanding and connect the relationships in the phenomenon. According to Butler-Kisber and Poldma (2010), moreover, the collage provides a useful tool to conceptualise ideas and give out different sides which enables a researcher to get a deep understanding of the phenomenon. The collage draws on the participant's feelings, unconscious thoughts, and experiences about a phenomenon that is contextually based. Furthermore, the collage focuses on content and can be analysed based on this. Butler-Kisber and Poldma (2010) contend that

everyone can make a collage even those who are not artistically talented because it is one of the untaught-based processes.

Wilson, Mandich and Magalhães (2016) describe collages as the best data generation method for qualitative data. It is one of the methods which is based on retrieving in-depth and new understanding. Butler-Kisber and Poldma (2010) assert that the narratives revealed through collage bring out the individual's inner world. On the same note, a collage reveals how individuals experience the world. This data generation method uncovers participants' emotional facets. On that note, Butler-Kisber and Poldma (2010) contend that collages are based more on psychology theory than on art.

Butler-Kisber and Poldma, (2010) further contend that when a collage is developed, the focus is on questions that arise in the analysis process. For my research questions, collage was used to generate visual data. I chose this method because I needed to explore how my participants feel about teaching organic chemistry in technical sciences grade 12. Collages allowed my participants to be hands-on regardless of perceived artistic ability (Mantzaris & Pillay, 2019). Mackworth-Young et al. (2021) highlight that collages disclose the numerous strata of identity. Therefore, collages were an effective tool in generating data for this study as it allowed me to understand teacher identities and emotions in greater detail.

3.7 Research context

This study was conducted in five schools in the Harry Gwala and Ugu districts of KwaZulu-Natal. Two of the schools are in the Ugu district and three are in the Harry Gwala district. The schools introduced the subject technical sciences in 2013 when the KwaZulu-Natal Department of Education initially introduced technical sciences and technical mathematics in the services subject package. In all these schools, the first matric class writing examinations on the subject was in 2019, which means teachers teaching technical sciences have more than five years of experience in teaching technical sciences.

Three schools are located in deep rural areas, one in a semi-rural area, and one is located in an urban area. Four schools offer both technical sciences and physical sciences, while the other school phased out physical sciences after introducing technical sciences. The schools have a science department, technical department, commerce, and humanities department led by departmental heads. Technical sciences fall under the technical department. The ratio of teachers to learners in technical sciences classes is one to fifteen, and the average number of learners per class in these schools is twenty learners. In all of these schools, there are no

laboratories assigned for technical sciences but they use physical sciences laboratories for practical activities.

Learners who study technical subjects had to choose between physical sciences and technical sciences. Technical sciences is done by those learners who are skill-based, and who are good in practical work, whereas, physical sciences is taken by learners who are more theory-inclined. The teachers teaching technical sciences are teachers who specialise in physical sciences. When the technical sciences subject was introduced, teachers who were teaching physical sciences booked for training, where they were introduced to technical sciences. That is how teachers were developed to be able to teach technical sciences. The workshops that teachers attended were content-based and also practical-based since technical sciences requires learners to acquire fifty percent for practical activities and fifty percent for theoretical activities for them to pass. Since the subject is newly introduced, the Department of Education is still supporting schools by offering workshops for training teachers.

3.8 Purposive sampling

In order to select participants for the study, the selection method must yield participants who will give relevant information for the study. Taherdoost (2016) define the purposive sampling strategy as a strategy where participants are selected intentionally to generate important information that cannot be obtained from other selections. Furthermore, Etikan et al. (2016) describe purposive sampling as one non-probability technique where a researcher can set the number of participants in the sample. Taherdoost (2016) contends that the researcher decides who can provide the information by considering participants' experiences and the knowledge they possess.

Campbell et al. (2020) suggests that with the purposive sampling technique, the researcher selects the participants who are most likely to produce relevant and useful information. Similarly, Andrade (2021) state that the purposive technique gives a sample that serves the purpose of the study. They also claim that to have relevant participants, the purposive sampling strategy helps the researcher to focus on participants sharing the same characteristic which will benefit the study with relevant, rich, and proper information of value to the study. In the same vein, Etikan et al. (2016) agree that with purposive sampling, the researcher already has something in mind regarding the study and requires participants that will suit the purpose of the study. In addition, in purposive sampling, the researcher chooses the participants based on the nature, purpose, and type of the study.

According to Campbell et al. (2020), purposive sampling works best in a qualitative study. In that sense, when qualitative research is conducted, the purposive sampling strategy helps in choosing participants while knowing the aim and objectives of the study. Campbell et al. (2020) attest that the underlying assumption is that people possess different opinions and views which are very important to the phenomenon of the study. In the same vein, Andrade (2021) corroborate that through the narratives of chosen participants using purposive sampling, information that is generated is in-depth and detailed about the study. However, Etikan et al. (2016) contend that whenever a researcher employs purposive sampling in a study, validity measures and competence should be ensured.

This study employed a purposive sampling technique; five schools that offered technical sciences in two districts of KwaZulu-Natal were identified. These schools were identified since they were the only schools that had teachers to whom the purpose of the study was relevant. The reason for choosing two districts was because these districts had schools that were accessible to the researcher and were the only schools offering technical sciences.

I purposively selected five participants who were technical sciences teachers at the five different high schools in the Harry Gwala and Ugu district. The selection of the participants was based on the number of years they had taught technical sciences grade 12 classes. The selected participants had all taught technical sciences in grade 12 for more than five years. The criteria proposed by Creswell (2017) – the availability of participants, enthusiasm to take part in the study, their enthusiasm to provide information, familiarity with the phenomenon, and the capability to offer data on the field of the study – was used as a directive in choosing participants for this study.

According to Ntinda (2018), a study that adopts narrative inquiry requires the researcher to collaborate closely with participants, although this is time-consuming. Therefore, Andrade (2021) assert that the purposive sampling strategy is effective since it works best for a small population. The five schools were selected with the most relevant participants. Etikan et al. (2016) affirm that the researcher using purposive sampling is interested in obtaining in-depth knowledge from individuals who possess it. Participants identified in these schools possessed in-depth knowledge and were able to provide rich, in-depth data for the study.

3.9 Data analysis

The data generated in this study using semi-structured interviews and collages was qualitative and needed several explanations. Moreover, qualitative data relies on interpretation. Cohen et

al. (2017) contend that data analysis in qualitative research is differentiated by merging analysis and interpretations, as well as merging data generation with data analysis.

Thematic analysis was used to analyse the data in this study. Morgan (2022) defines thematic analysis as a type of qualitative analysis that is used to analyse patterns displayed by data as themes. Similarly, Clarke and Braun (2016) define thematic analysis as a method of identifying, analysing, and reporting patterns in the generated data. Clarke and Braun (2016) identify the thematic analysis method as the most flexible. In the same vein, Morgan (2022) asserts that thematic analysis assists the researcher in organising data in detail to attain a better understanding of the phenomenon of the study. Similarly, Cohen et al. (2017) argue that thematic analysis helps the researcher to discover the relationship between concepts and be able to compare them with simulated data. This then results in the researcher being able to link various concepts and opinions of participants and compare them with data that has been gathered in different situations during the research. Morgan (2022) further explains that the codes that are developed for themes are then applied and linked to raw data as summary markers for analysis, which should include the phenomenon.

Clarke and Braun (2016) mention that thematic analysis is characterised by theories that value the ways individuals make meanings of their experiences. Moreover, Clarke and Braun (2016) maintain that the social context affects the meanings provided by participants. On that note, Clarke and Braun (2016) contend that the focus of thematic analysis is on reflecting reality and addressing issues experienced in reality. In addition, Clarke and Braun (2016) maintain that the identified themes capture something about the data and the research question and represent some level of patterned responses and meanings in the data set.

The thematic analysis of the interpretive data of this study was inductive. Theophilus (2018) describes inductive analysis as the approach that works from raw data obtained from participants, derived, and categorised into emerging themes. Furthermore, the inductive analysis helped the researcher to reveal the meaning and understanding of data through a summary of sub-topics, classifications, and arrangements. Olumba et al. (2022) mention that inductive analysis starts from unproven facts that emerge from generated data and ends with aligning those concepts with a theoretical framework. In this study, an inductive approach was used, and the sub-topics or themes were created from key research questions to make sense of the generated data. However, Theophilus (2018) contends that the process of inductive analysis is two-way; a researcher also analyses the emerging themes from data generated in line with

the literature to make sense of emerging themes. Therefore, the theory of Hargreaves (2001) on emotional geographies of teaching and the three dimensions of teacher identities (Gu & Day, 2007) were used when analysing the data. The literature reviewed was also used to understand and make sense of the meaning of emerging themes.

In this study, the narrative data generated from the semi-structured interviews was coded and organised into patterns and themes. Furthermore, participants were asked to write a paragraph explaining their collages. The paragraphs were used to analyse the collages. The organisation of data, codes, and themes was guided by the three research questions, which were analysed inductively.

3.10 Trustworthiness

Nowell et al. (2017) assert that qualitative research must demonstrate that data analysis has been conducted accurately and consistently to allow the reader to determine whether the process is believable. In the same vein, Elo et al. (2014) emphasise that it is important to scrutinise trustworthiness in the data generation and reporting phase. In addition, Stahl and King (2020) asserts that the content that is analysed and reported needs to be valid and understandable for the benefit of reviewers. Stahl and King (2020) further suggests that the trustworthiness of qualitative data analysis can be considered by ensuring:

- Credibility in preference to validity,
- Transferability in preference to generalisations,
- Dependability in preference to reliability, and
- Confirmability in preference to objectivity.

According to Stahl and King (2020), to ensure that the credibility of the study is considered, the study should show congruency with reality. In addition, the study should measure what it intended. This can be attained through the engagement of the researcher with participants to gain more understanding of the research context. Stahl and King (2020) further explains that to ensure that the data gathered is relevant to the study, triangulation may be applied. In addition, participants should be allowed to withdraw whenever they feel to ensure the study has participants who are willing to participate to retrieve genuine data.

Transferability is the level to which the outcomes of the study can be used for or generalised to other situations (Shenton, 2004). Stahl and King (2020) reveals, however, that a study's findings and conclusions are only applicable to the population that was investigated. Thus, it

is difficult to generalise for all contexts. It is therefore important that the researcher ensure that enough contextual information about the site is given.

Stahl and King (2020) affirms that the researcher needs to describe what was planned in detail and what was accomplished to allow the research being repeated in the future to establish reliability. Confirmability ensures that findings report the experiences and ideas of participants, not the researcher. The researcher must not be biased when analysing data and triangulation should be considered to confirm the findings and reduce the biases of the researcher.

I ensured the trustworthiness of data generation in this study by employing the triangulation method in generating data. Data was generated by semi-structured interviews and collages. Before conducting the interviews, I clearly stated my position as a researcher to my participants so that they would respond to me in the position of a researcher not as a colleague. The interviews were recorded to ensure that the analysed data was valid, and I used probing questions which enabled me to understand in detail the responses of my participants. Transcribed interviews were given back to participants for member checks. Charts from the collages were also kept to be useful to other researchers and teachers who might need to use generated data.

3.11 Ethical issues

I initially applied for permission to conduct the study from the KwaZulu-Natal Provincial Department of Education. I also completed an application for ethical clearance from the university's research and ethics committee. Participants signed consent forms confirming the study was voluntary. I explained to participants that they had a right to withdraw from the study should they wish to do so. I ensured that my participants' identities were confidential and protected by using pseudonyms. Thus, participants were protected from harm by maintaining their anonymity. The participants' rights to consent were protected as they willingly participated, and their consent was petitioned before their involvement. I displayed a good measure of integrity and honesty throughout the study to ensure that the research was of high quality (Punch, 2009). The participants of my study received considerate treatment during the research process and their responses were kept confidential as even the Department of Education could not know who was responding.

According to Fahie (2014), for the personal safety of participants, the researcher should refrain from disclosing personal details like home addresses or other private contact details, and monitor carefully the interview to assess the emotional impact and response of the interviewee.

Therefore, information generated from the participants in this study was never discussed or disclosed to anyone except my supervisor and so remained confidential. I did not expose my participants and the schools where research was conducted to any form of physical, emotional, or psychological harm. In my study, there was no situation in which and the participants were embarrassed, ashamed, or caused fear. After research, I gave feedback to my participants about my study

3.12 Conclusion

This chapter discussed the research design and methodology that was employed in this study. The interpretative paradigm, qualitative research approach, and narrative research design were discussed in this chapter and justified as suitable for this study. The chapter also discussed the data generation methods: semi-structured interviews and collages. The research context, the purposive sampling strategy, and the criteria that were used to select participants of this study were discussed. Thematic analysis was then discussed as it was used to analyse data obtained from participants. Furthermore, inductive analysis was discussed as all questions were analysed inductively. This chapter concluded with a discussion of trustworthiness and ethical concerns that were considered in the study. The following chapter presents and analyses the data in response to the three research questions.

Chapter 4

Presentation and Analysis of Data

4.1 Introduction

The previous chapter outlined the methodological approach that was applied in this study to address the research questions. This chapter focuses on presenting and analysing the generated data. The data was generated through semi-structured interviews and collages. The transcripts from semi-structured interviews were read repeatedly to gain an in-depth understanding of the transcripts. The narratives from collages were also read and examined numerous times to gain more understanding of the presented data. The three dimensions of teacher identity by Gu and Day (2007) and emotional geographies of teaching by Hargreaves (2001) were employed to analyse and interpret results. In addition, the relevant literature that was reviewed in Chapter two was also used to make sense of the findings of this study.

Data was generated from five teachers – three teachers from the Harry Gwala district and two teachers from the Ugu district. These participants are currently teaching technical sciences in Grade 12 and they have taught technical sciences for more than five years. The narratives gathered from participants were cross-checked by them to ensure validity. The generated data was coded and categorised to identify common themes. The themes were analysed to understand how technical sciences teachers' identities and emotions influence their teaching of organic chemistry. Direct quotations were used to display participant's views. Participant's responses are written in italics. This chapter analyses data in response to the following research questions:

1. What do grade 12 technical sciences teachers' stories tell us about their personal and professional identities in their teaching of organic chemistry?
2. What emotions do grade 12 technical sciences teachers experience when teaching organic chemistry?
3. How do grade 12 technical sciences teachers' emotions influence their teaching of organic chemistry?

According to Beauchamp and Thomas' (2009), the formation of identity is a continuous process influenced by the individual and their context. The participants' responses highlighted that their identities differed and were shaped by their individual and social contexts. Thus, this

chapter begins with an outline of the biographical profiles of the five participants, who were interviewed and designed collages. The five participants were given pseudonyms to protect their identities and encourage them to communicate freely and without fear. The pseudonyms allocated to participants were: Ayabonga, Florence, Nosipho, Maluleka, and Lulu. Next, this chapter presents the data and analysis of the data to address the three research questions that guided this study.

4.2 Biographical profile of participants

4.2.1 Ayabonga's narrative

Ayabonga is 55 years old. He is a qualified physical sciences and life sciences teacher. He is married with two children. He has taught physical sciences for ten years and has taught technical sciences for five years, and therefore has 15 years of teaching experience. During the time of this study, Ayabonga was teaching technical sciences in grade 12 and physical sciences in grades ten and 11. He obtained his first degree in 1997, a Bachelor of Sciences degree majoring in natural resource management. He also achieved a certificate in school management in 2005. In addition, he obtained his Postgraduate Certificate in Education in 2010, majoring in physical sciences and natural sciences. In 2015, he achieved his Master's in Education specialising in chemistry.

Ayabonga was raised and educated in Ghana for his primary education. He mentioned that *the teaching profession was never the field of my interest.* After finishing form six, he volunteered for National Service where he was posted to different schools in different departments. He was posted to one of the junior secondary schools, and that is where he discovered that he enjoyed being a teacher. When he interacted with the community and interacted with *learners that is where [he] developed a love of becoming a teacher, from there [he] learned to understand that teaching is a calling.* He added, *It is not everyone who can be a teacher, I've learned that there are people who just decide that they want to be a teacher, I will get a qualification, and after I will just leave and get to another field.* He suggested that some individuals use their teaching qualification as a stepping stone.

The school that Ayabonga teaches at is a former Model C school, which is classified as a quintile four school. When he came to the school with the qualifications and training that he attained to be a better teacher, he produced good results. The school was able to get a sponsor to support the science department. With the funding the school received from the sponsor, he was able to study for his Master's degree and purchase apparatus and equipment to conduct

practical experiments in science subjects. During this time, Ayabonga taught organic chemistry very effectively covering theory and practical activities. However, during the time of this study, he no longer had the equipment and facilities that made the teaching of organic chemistry effective, since the funding was used for other subjects with practical experiments and therefore the equipment and chemicals were either exhausted or out of use.

Ayabonga described organic chemistry as a very interesting topic, especially the naming and identifying of the properties of chemicals. Nevertheless, he suggested that he experienced difficulty teaching the section on chemical reactions since they did not have sufficient resources. He shared: *I don't want to teach for memorising and passing the exams but I want my learners to learn so they will use whatever they learned to develop the society.* He added that he prepares for all the lessons he has to teach and tries to make them more practical and relevant for the learners' level. Ayabonga further shared that he plans his lessons to be more practical and realistic, and he asks his learners why they want to learn organic chemistry, since the language is unfamiliar to them. Whenever he had to teach organic chemistry, he experienced "mixed feelings" because organic chemistry involves much practical work and he had to teach it in an environment where it is not possible to do practical work due to lack of chemicals and resources. He further mentioned: *My beliefs in being a science teacher is I should give all learners a chance and opportunity to explore and become better people in the society.*

In addition, Ayabonga believes that instilling a good background in science is a powerful weapon to change society. He believes that everyone deserves a chance, and that *teaching is bringing up children in the society.* He added: *From my experience, I learned that we cannot say there are people who can do this and there are people who cannot do it, but everyone must be given a chance to try*. Ayabonga's professional identity is being a *lifelong learner,* to become a better teacher who helps learners to become better citizens.

Ayabonga asserted that he stays motivated to teach under the school conditions and always finds a way to make his lessons more effective through his firm teacher identity which is based on his belief that the learners he is teaching could be the ones who change society. He firmly believes that his impact on learners contributes to the future of society. The emotions that he experiences when teaching organic chemistry make him stay motivated by planning lessons that help learners understand organic chemistry better and achieve better results.

4.2.2 Florence's narrative

Florence is a qualified teacher. She is married and she has two biological children and one stepson. Florence obtained her Bachelor of Education degree in 2013, majoring in physical sciences and mathematics. She has eight years of teaching experience, three years teaching physical sciences, and five years teaching technical sciences. During the time of this study, Florence was teaching technical sciences in grades ten to 12.

Florence grew up in a rural area where most of the community members were not well educated. She furthered her studies and got a job in a school located in the community where she grew up. She shared that *in [her] community, a teacher is viewed as a role model and someone who can save the community, a teacher is seen as a better and more valuable person who needs to be respected the most*. From childhood, Florence always wanted to become a teacher. However, she mentioned that, *when I started teaching, the challenges I experienced were far against what I thought about being a teacher.*

The school that Florence is teaching at does not have a science laboratory and there is no equipment to conduct the practical activities. According to Florence, during practical activities, learners understand the concepts easily and if learners do not conduct practical activities, they end up failing organic chemistry because they did not understand chemical reactions. She acknowledges, *the significance of practical activities in teaching organic chemistry is major so I end up theorising chemical reactions in organic chemistry*.

Florence shared that she experiences mixed feelings when teaching organic chemistry. For the sections on naming and introducing organic molecules, she feels enthusiastic to teach, and even her learners enjoy these sections since they are not complex. However, she becomes frustrated and anxious when introducing and teaching about chemical reactions, as these sections are more complex.

Florence strongly believes that a teacher should lead by example and views herself as a role model to her learners. Her teacher identity corresponds with her practice, and she explained that while teaching, she remains positive and eager to teach, despite the school environment not being conducive to teaching and learning. She added: *I view myself as a person who should always leave a good mark on learners so that even if they are no longer at school they can still remember my impact on their lives*. *Being such a teacher makes learners love the subject and I'm a parent to them.*

Florence believes that by her being a better teacher, she leads by example so her learners can have a better education. She developed herself professionally by attending professional development workshops and preparing her learners with past examination papers so that they pass the examinations. She does not allow the school context to change the person she believes she should be, but she finds ways to overcome the challenges for the benefit of her learners.

4.2.3 Nosipho's narrative

Nosipho is a qualified teacher who majored in physical sciences and sports sciences. She obtained her Bachelor of Education degree in 2016. She has seven years teaching experience and has been teaching technical sciences for five years. She is a single parent to two boys and her parents support her. During the time of this study, Nosipho was teaching technical sciences from grades ten to twelve.

Nosipho shared that her mother was a teacher and her father was a principal, therefore *in [her] family education always comes first*. *[She] was always motivated to become a teacher so that [she] would be respected like her mom and dad.* She added that *being a teacher was in [her] genes*. She recalled seeing her mother and father helping children from disadvantaged homes and supporting them, which made her believe that everyone deserves a chance to be successful. She became a science teacher because she saw a need to help learners with scientific knowledge. She believes that a teacher should lead by example and that whenever you teach learners you should not show them negative feelings you have about a topic.

Nosipho suggests that teaching organic chemistry is a challenge for learners who do technical sciences since they do not have good background knowledge in chemistry. She explained that these learners start organic chemistry in grade 12, and experience difficulties understanding new terminology in organic chemistry, which has its own language. Therefore, it takes some time for them to acquire knowledge and differentiate between terms and names of molecules. This requires that teachers be patient and innovative when it comes to teaching the new content in organic chemistry to learners.

Moreover, the nature of technical sciences requires learners to engage more in practical activities. The school that Nosipho is teaching at is located in a rural area and does not have enough resources and equipment to conduct practical activities. She added that, *I find it hard to help learners understand the reactions that are to be taught in organic chemistry*. *Even so, I stay motivated to teach my learners because I believe that above all I still need to be a teacher who my learners believe is the best*.

Nosipho believes that she is a role model and the best teacher. She draws on her personal and professional identities when teaching organic chemistry and always strives to be the best teacher. She watches YouTube videos to help her to teach better since there is a lack of resources at her school. She explained: *Being a science teacher is not easy, the language, the type of learners, and even the environment we teach also make it harder but I always strive for the best.*

4.2.4 Maluleka's narrative

Maluleka is a 57-year-old, qualified teacher who majored in physical sciences and natural sciences. He obtained his Bachelor of Sciences degree majoring in chemistry, and then obtained a Postgraduate Certificate in Education. He also has an Honours degree in physical sciences and obtained his Master's in Education degree, specialising in physical sciences. Maluleka is currently doing his PhD in physical sciences. He has been teaching for 29 years, with 24 years' experience teaching physical sciences, and five years' experience teaching technical sciences. During this study, he was a departmental head for sciences at his school and also a teacher for technical sciences grades ten to 12.

Teaching was not his chosen career, but later on he realised that he had a gift for sharing knowledge with learners. He shared: *I just realised that teaching is a calling for me because seeing learners coming to my classroom and gaining knowledge was very pleasing.* Through his teaching, *[he] discovered that organic chemistry requires lots of chemicals and apparatus* so that learners can engage in experiments and be able to observe many chemical reactions so that they can consolidate theory with the practical.

Although Maluleka is teaching at a school that has laboratories, chemicals are not available. He finds teaching organic chemistry so *frustrating as some learners learn better by seeing* and he needs to improvise. However, Maluleka is motivated by the type of learners he teaches, who are eager to learn. Therefore, he says, it becomes easy. He adds that he appreciates the support from the school management team, the education department, and parents, which greatly influences his teaching. He explains: *I always find it easy to teach if parents are also involved in their children's education since such support is so valuable.*

He sees himself as a role model, *as someone who should pave learners' way, to sharpen their thinking.* He strives to help learners to be at higher positions than where they are and be able to have a better future. He shared: *I feel like a black child deserves to be given a chance especially in the science field since they have been disadvantaged for a long time*. Mluleka

believes that he should help his learners reach a point they could not reach before since he was disadvantaged and not guided during his schooling.

Maluleka suggests that everyone should be lifelong learners. Regardless of his experience and qualifications, he still attends just in time (JIT) workshops where they share ideas and help one another with how to teach certain topics. The subject advisors are also supportive and helpful with queries. His teacher identity is evident in his teaching as Maluleka finds a way to be an effective teacher to his learners.

4.2.5 Lulu's narrative

Lulu is a qualified teacher; her majors were physical sciences and mathematics. She is married and has two sons, and her husband is a lecturer at a university in KwaZulu-Natal. Lulu studied towards a Bachelor of Science degree which she obtained in 2010, majoring in chemistry. Since she could not find a job, she studied towards a Postgraduate Certificate in Education, which she obtained in 2013. Lulu said: *Teaching was never a first-choice career, all I wanted was to be an engineer*. However, she could not do engineering because she had no one to guide her.

Lulu got a teaching post at the school where she completed her schooling. After getting married, she had to get a transfer to be closer to her husband. Lulu has ten years of teaching experience, five years teaching physical sciences, and five years teaching technical sciences. At the time of this study, she was teaching technical sciences in grade 12 and physical sciences in grades ten to 12.

Lulu described chemistry as her favourite section in technical sciences, especially since in her Bachelor of Sciences degree she specialised in chemistry. Even during her schooling, her physical sciences teacher enjoyed teaching chemistry more than physical sciences. Lulu feels enthusiastic every time she has to teach organic chemistry. She shared that her learners seem to enjoy learning organic chemistry and pass the subject.

The school that she currently teaches at is one of the best schools, and is located in an urban area and has sufficient resources. Her school management team is very supportive, and the parents are involved in their children's progress. Lulu commented that since teaching was not her favourite career, during her first year of teaching, the matric results were not so impressive. Nevertheless, due to the support of the school management team and learners' parents, as well as interacting with other teachers at workshops and marking centres, her teaching practice improved. Through networking with other teachers, she was able to apply new teaching methods that helped her learners to pass.

Lulu sees herself as a mother, a partner with parents, and a role model. She believes being a teacher requires one to engage parents to gain more support and lower the stress about disciplining learners. Lulu is eager to learn, and she sees herself as a lifelong learner. She attends professional development workshops to gain more knowledge so that she can be a better teacher to her learners.

4.3 Analysis of data and emerging themes

This section presents the data that was generated through semi-structured interviews and collages. The data generated was analysed to address the three research questions that guided this study. Thematic analysis was used to interpret and make meaning of the data in this narrative study. By using thematic analysis, the codes and categories that were derived from data were merged into themes. The emerging themes obtained highlighted the influence of teacher identities and emotions in teaching organic chemistry in technical sciences grade 12. The three research questions were analysed inductively to identify themes that emerged from the data generated. The data was analysed and presented according to the research questions.

4.4 Personal and professional identities of technical sciences teachers

This section presents and analyses data that addresses research question one:

What do grade 12 technical sciences teachers' stories tell us about their personal and professional identities and their teaching of organic chemistry?

According to Henna et al. (2022), teacher identities depend on how teachers picture themselves and how they want to be viewed in the profession of teaching. Zembylas (2015) contends that teacher identities are influenced by teachers' experiences. In the same vein, Beijaard et al. (2004) . assert that teacher identities are dynamic and influenced by their social situations. Participants of this study were from different contexts and the data gathered showed that their diverse contexts influenced and shaped their personal and professional identities. How technical sciences teachers viewed themselves was influenced by their social, cultural, and political contexts. Data indicated that technical sciences teachers displayed different teacher identities, and that their teacher identities were shaped by their individual experiences.

Research question one was analysed inductively. From the data that was gathered, I coded words and phrases that highlighted teacher identities. I then looked for patterns and similarities to identify emerging themes. The four themes related to teacher identities that emerged were:

teaching as a calling, teacher as a lifelong learner, teacher as a role model, and teacher as a motivator.

4.4.1 Teaching as a calling

The participants revealed that when they finished their schooling, the careers that they had an interest in varied. Some participants mentioned that teaching was not their first or favourite choice as a career, as they wanted to be engineers instead. This was evident in the responses of Maluleka, Ayabonga, and Lulu who stated that teaching was never the profession of their interest, they only wanted to be engineers. However, their personal and professional journeys led them to teaching as a career. Most participants mentioned that when they started teaching, they realised that teaching was a calling.

Ayabonga mentioned that he studied Forestry and after finishing his training, he was placed in one of the schools to complete community service. Through his engagement and interaction with learners, he developed a love and passion for becoming a teacher. Ayabonga said, *When I interacted with the community and socialised with learners, that is where I developed a love of becoming a teacher, from there I learned to understand that teaching is a calling*.

Similarly, Maluleka said: *I tried to do engineering which I found most fascinating, but still through my experience I just realised that teaching is a calling for me.* He elaborated that he was very pleased when learners acquired knowledge in his classroom. This suggests that although engineering was Maluleka's first choice as a career, his teaching experience made him realise that he enjoyed teaching. He therefore mentions that teaching was a calling for him and that he was meant to be a teacher.

On the same note, Nosipho's family situation made her realise that teaching was the most suitable profession for her. She elaborated that she was motivated to become a teacher and that teaching was in her genes. She observed her mother and father supporting learners from disadvantaged backgrounds and this made her realise that these learners deserved an opportunity to progress and be successful. She therefore described teaching as a calling for her.

The participant's experiences and socialisation influenced the way they viewed the teaching profession. This is in line with research such as Beijaard et al. (2004) . who state that teacher identity is molded in a social context by the periods that people pass through. Similarly, Zembylas (2015) argues that teacher identity can be seen as a viewpoint that teachers develop based on themselves, their learners, their learner's learning, methods of instruction, curriculum,

and schools as social institutions. Thus, the context plays a vital role in shaping teacher identities (Beijaard et al., 2004).

The analysis of this theme, teaching is a calling, resonates with Gu and Day's (2007) three dimensions of teacher identity, the personal, professional, and situated dimensions. Gu and Day (2007) maintain that there is an interaction between teachers' lives and their work in the field of teaching. This was evident in this study as Ayabonga and Maluleka got interested in teaching after doing actual teaching in their lives. The study conducted by Gu and Day (2007) displayed that teachers' beliefs and their personal lives influence their classroom practices; therefore, teachers need personal and professional support in order for them to be resilient. Gu and Day (2007) further mention that teachers' experiences in their social contexts result in their effectiveness in producing quality work. Once teachers in this study realised that teaching was a calling for them, they were able to overcome the challenges they faced when teaching organic chemistry. Teachers become passionate about doing their job when they love it, as Nosipho said *teaching is in my genes.* The situated and personal dimensions of teacher identity were revealed in this study when Ayabonga and Maluleka become passionate about their work and improved the way they saw themselves when teaching organic chemistry. Gu and Day (2007) argue that teachers need to have a solid self-perception to accomplish their professional duties which will eventually shape their identity.

4.4.2 Teacher as a lifelong learner

Participants mentioned that after engaging in teaching, they believed that they needed to become better teachers not only for teaching organic chemistry but also as better teachers to their learners. Their identities revealed that they always strived to produce effective lessons and be able to manage their learners with regard to discipline. Participants felt that the training that they received at universities was not enough for them to be effective teachers of organic chemistry. They expressed that there was an aspect where they needed more training. Ayabonga expressed his feelings with his classroom management skills:

I realised that the PGCE qualification was not enough. When I was appointed as Departmental Head, I thought I needed to get training, so I did a Certificate in School Management. This taught me to be able to manage not only the school but also the class I teach sciences. This suggests that although Ayabonga had a teaching qualification and was enjoying teaching, he still saw the need to further his studies in school management. Therefore, he realised that

acquiring more management skills would not only enable him to perform his duties as Departmental Head but also manage his classroom more effectively.

On the same note, Nosipho mentioned that she realised when she finished her training at university that there were certain topics in organic chemistry which she was not very confident about teaching. She elaborated that she attended training workshops offered by the Department of Education to help improve her knowledge on challenging topics in organic chemistry and enhance her teaching.

Similarly, Maluleka strongly believes that a teacher is a lifelong learner and *that you never stop learning.* He shared that he attended JIT workshops where teachers share ideas and help each other by sharing teaching strategies about how to teach certain topics in organic chemistry. He added: *The subject advisors are also very supportive, they help with whatever queries we have.*

Likewise, Lulu mentioned that she was eager to see her learners doing well in organic chemistry, which is considered a difficult topic in technical sciences. This involved further learning on her part. She expressed her feelings about helping her learners to pass organic chemistry:

During my first year of teaching, my learners passed technical sciences but their marks was not good. I was teaching without any experience, and I realised that you never stop learning. I was appointed as a marker the following year and this is when I started interacting and networking with other teachers. I was able to learn effective teaching strategies that helped my learners to achieve good marks.

Responses from participants about being lifelong learners resonate with Zembylas (2015) who emphasises that teacher identity formation requires teachers to participate in professional development and learning. In this study, Nosipho and Maluleka showed their willingness to attend the departmental workshops and training to enhance their professional development. Such involvement contributed to the development of their professional identities, which in turn enhanced their teaching of organic chemistry. The study conducted by Woodraj (2022) highlighted that the effectiveness of teachers is the product of their identities which develop as teachers participate and commit themselves to the profession. In the same vein, Gholami et al. (2021) contend that teachers' classroom teaching experience, knowledge, and passion serve as internal factors that affect their professional identity. The participants of this study displayed professional identities that overlapped with their teaching of organic chemistry, as Ayabonga, Lulu, and Nosipho indicated that they were concerned about being good teachers.

The theme of the teacher as a lifelong learner was analysed drawing on Gu and Day's (2007) three dimensions of teacher identity, namely, the personal, professional, and situated dimensions. Gu and Day (2007) explain that teachers need to keep the three dimensions balanced for them to be able to face challenges in their work. In addition, when teachers maintain balance within the three dimensions, they become effective and committed to their work. The professional dimension guides teachers when they engage in classroom practices. In this study, Lulu showed confidence in teaching after engaging in professional development programmes that were designed to improve knowledge of concepts taught in organic chemistry. Nosipho also confirmed that after getting more training from departmental workshops, she gained confidence and was positive about teaching organic chemistry.

4.4.3 Teacher as a role model

Participants revealed that the teaching profession requires teachers to be good leaders and serve as role models. This means that teachers should set a good example for their learners. The generated data revealed that teachers were regarded as valuable professionals who have a great impact on transforming society and encourage learners to overcome poverty. Results highlighted that participants emphasised the importance of education and encouraged learners to strive for better results. Florence explained that in her community, teachers are regarded as role models and people who can save the community. She further shared:

I grew up in a rural area where most of the community members are not well educated. I furthered my studies in the teaching profession. The teacher is seen as a better and more valuable person who needs to be respected the most. Then I became motivated and wanted to be a teacher.

Florence mentioned that she ensures that she makes a good impression on her learners and gives them hope that they can succeed through education. She said that she is *not only a teacher; [she is] mother to [her] learners in a manner that even if [her] learners are no longer at school they still remember [her]*. In the same vein, Nosipho expressed that even though organic chemistry is challenging to teach, her belief in her being a good role model helps her to overcome challenges and does not influence her teaching negatively. She said, *I believe that teachers should lead by example and when they teach learners, they do not need to show them negative feelings they have towards a topic.*

Similarly, Ayabonga described himself as a person who *leads* learners to a brighter future. He further mentioned that he *believes that for society to have a good future, learners should be well educated, and that [he] views [him]self as being responsible for paving learners' future.*

Correspondingly, Maluleka views himself *as a role model, someone who should pave learners' way, to sharpen their thinking. Helping them to be at higher positions than where they are, helping learners to be able to have a better future.* He added that he believes that *"a black child deserves to be given a chance especially in the science field since they have been disadvantaged for a long time.* Maluleka believed that he should help learners to reach a point that they could not reach since they were disadvantaged and not guided.

Zembylas (2015) emphasises that teacher identities are related to the political process; and can be seen as the product of maintaining self. It was evident from participants' responses that views about teachers in their communities shaped the way they viewed themselves as teachers. In addition, Beijaard et al. (2004) . contend that teacher identity is formed within a social context and the stages that people pass through. Florence revealed that she grew up in communities that viewed teachers as role models and people to whom young children could look up. Similarly, as Ayabonga engaged in teaching, he also viewed himself as a role model. Learners also looked up to teachers as their role models. Being role models, participants managed to strive for the best in their teaching of organic chemistry, and they used effective teaching strategies to deliver successful lessons to their learners. Beijaard et al. (2004) suggest that teacher identities are molded by social dynamics, therefore, teachers have diverse, yet unique, identities. This was evident in the narratives of participants in this study.

The data generated also suggested that teachers teach how they were taught during their schooling. This resonates with Gu and Day (2007) who emphasise that teachers are able to work if their professional lives are linked with their identities. Participants viewed themselves as role models and, drawing on Gu and Day (2007), this identity is related to the personal dimension of teacher identity. Gu and Day's (2007) personal dimension describes how teachers' experiences and interactions with the environment outside the school influence their teaching. This suggests that when teachers teach, they reflect on their personal and professional experiences and lives, which influences the way they teach organic chemistry. The personal identity was evident in this study in Florence and Ayabonga's narratives as they described that they always strive to display the image of teachers with characteristics assigned by a society.

In addition, Gu and Day (2007) argue that the morals and values that teachers retain affect their behavior in the teaching profession.

4.4.4 Teacher as a motivator

Data generated also showed that technical sciences teachers believed that their role in teaching was not only based on implementing the curriculum and maintaining classroom discipline. Learner achievement also seemed to be a major concern for participants in the study. Participants revealed that encouraging learners to work hard against all odds had motivated their learners to achieve better results.

Ayabonga viewed himself as a *future builder*. He mentioned that he obtained a Certificate in Curriculum Development, which helped him to acquire new knowledge and skills as well as learn new teaching strategies that helped the weaker learners to achieve better results. Ayabonga believes that being a teacher who enables weaker learners to pass keeps learners' attitudes positive toward learning organic chemistry. According to Ayabonga, if his learners are motivated to learn, then his teaching is made easier and interesting. In his personal view, being a teacher means assisting and caring for learners, so they see where the future leads them.

Similarly, Maluleka shared that it was his *responsibility to help learners climb to where they can.* Maluleka believed that he should help learners reach a point that he could not reach as a learner since he was disadvantaged and not guided. Correspondingly, Florence explained that she viewed herself as someone who would always make a good impression on learners *so that even if they are no longer at school, they can still remember my impact on their lives*. According to Florence, being such a teacher makes her learners love the subject, technical sciences, and stay motivated to learn.

According to Ghanizadeh and Ostad (2016), a teacher's professional identity is intricately linked with the experiences a teacher has. In addition, as teachers interpret their experiences, they develop their professional identities. This could explain Ayabonga's view about his role in teaching as a *future builder*. From his experiences, he suggests that his learners were not the same, but through motivation he encouraged his learners to achieve good marks in organic chemistry. According to Ghanizadeh and Ostad (2016), professional identity is fundamental in the teaching profession. It not only outlines for teachers how they should behave in the classroom, but also helps them to understand their work, learners, and the community with which they deal.

Furthermore, Gu and Day (2007) argue that a teacher's commitment and resilience depend on the balance within the three dimensions of teacher identity. A change in one dimension might result in a loss of control in the other dimensions. Even though technical sciences teachers faced challenges when teaching organic chemistry due to the school environments, their commitment to teaching encouraged and motivated them. Gu and Day (2007) maintain that teachers' commitment and passion for teaching remain firm if their situated dimension is positive. The situated dimension encompasses the school context, which is mainly affected by learners' behaviour, school leadership, and school environment.

4.5 Teacher emotions and teaching technical sciences

This section presents and analyses data related to research question two:

What emotions do grade 12 technical sciences teachers experience when teaching organic chemistry?

The second research question was analysed inductively. From the data that was generated, words and phrases related to teacher emotions when teaching technical sciences were coded. Similar codes were grouped together to form themes. It was evident from participants responses that they experienced mixed emotions when teaching technical sciences. Participants also highlighted the factors that influenced their emotions when teaching technical sciences.

4.5.1 Mixed emotions

Emotions are crucial since they influence how teachers teach. The way teachers view reality is shaped by their emotions. The data in this study revealed that participants developed mixed emotions in their teaching of organic chemistry. The following themes highlighting the mixed emotions that participants experienced are discussed in the next section: enthusiasm and love as well as frustration and stress.

4.5.1.1 Enthusiasm and love

Participants revealed that organic chemistry is divided into three parts. Most of the participants maintained that the introduction to organic chemistry seems to be interesting as it focuses on simple and enjoyable strands of organic chemistry. As Florence explained, *Organic chemistry has different subtopics so when introducing the first part which is based on naming organic molecules and introducing the organic molecule I feel enthusiastic.* Having enthusiastic feelings makes it easy for her to teach learners the basics of organic chemistry. The enthusiastic feeling that Florence has overlaps with learners as she confirms that, even though organic

chemistry is first introduced in grade twelve, learners tend to be enthusiastic about learning the topic.

Similarly, Nosipho said *Organic chemistry is one of the topics that I loved from high school*. Nosipho was *influenced by [her] teacher to love chemistry*, who was a chemistry specialist. The love for organic chemistry that Nosipho has was transferred to her learners. All participants suggested that the first part of organic chemistry was the easiest and that learners grasped it easily and found it interesting. Lulu shared that she *love[s] organic chemistry and [she] enjoys teaching it the most*. Lulu added that *even in [her] high school, [she] achieved better marks in chemistry than in physics*. Lulu stated that more of her learners pass organic chemistry than physics, and, as a result, learners themselves become enthusiastic to learn when they are doing chemistry.

Hargreaves (1998) views emotions as sentiments of teaching. Teachers' emotions are very important since they shape how they teach or behave in the classroom. Similarly, Zembylas (2005) asserts that positive emotions have a great influence on teaching since they help teachers to construct solid relationships with learners. In addition, Richards (2020) contends that, if teachers experience positive emotions, for example, enjoyment, their actions toward learners are positive. According to Richards (2020), learners also become positive towards learning which yields positive learning outcomes. This was evident in the data generated by the study.

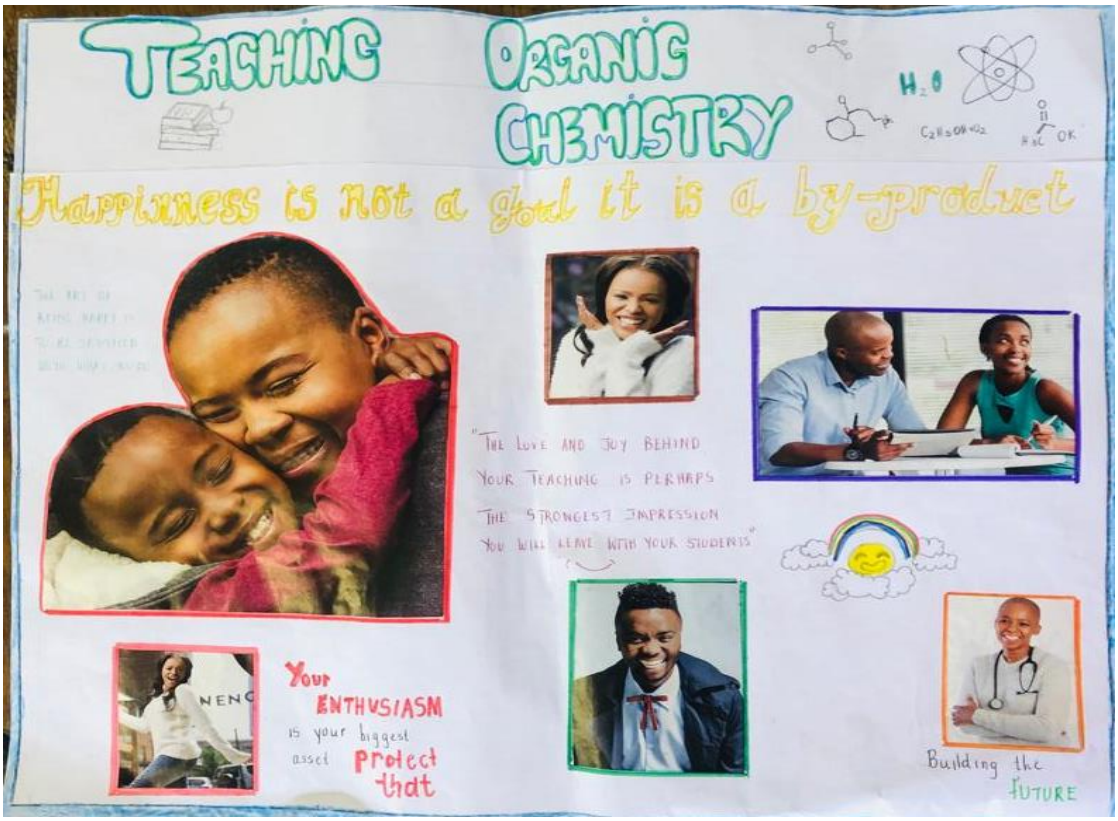

Figure 4.1 Lulu's Collage

Lulu indicated in her collage that she believes that teaching organic chemistry feels like building the futures of learners. She mentions that her positive feelings have a positive influence on her teaching and results in productive lessons. Lulu explains that she is happy and enthusiastic when teaching organic chemistry and believes that staying positive yields good results.

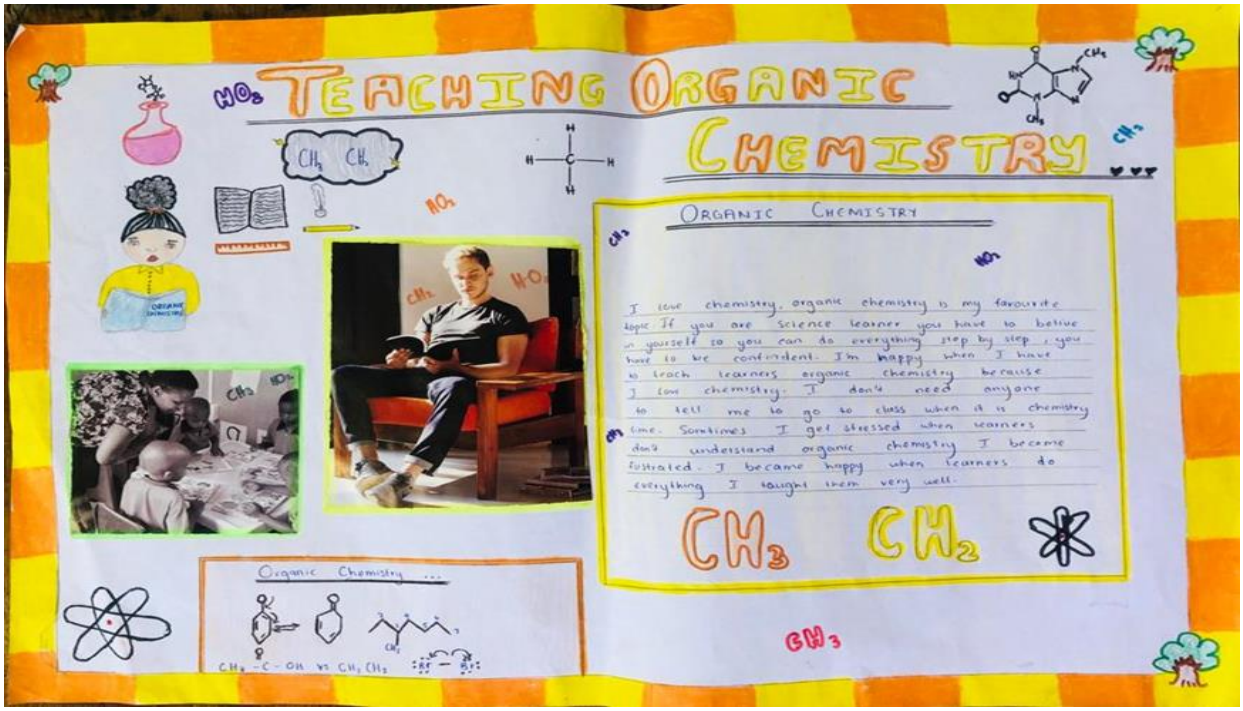

Figure 4.2 Nosipho's collage

Nosipho's collage highlights her *belief that learning never ends, and that to be productive a teacher needs to be a lifelong learner*. Nosipho's collage further highlights that, for learners to love organic chemistry, teachers must show that they love organic chemistry as well. She suggests that a teachers' love of organic chemistry is automatically transferred to learners. For teachers to love organic chemistry, they need to be knowledgeable about it.

Figure 4.3 Florence's Collage

Florence views herself as a person who should lead learners when teaching organic chemistry. When lessons are not going well, she feels like she fails learners. Mixed emotions develop through teaching organic chemistry, the faces in the collage show stress, happiness, passion, and joy.

The positive emotions displayed by participants were analysed drawing on Hargreaves's (2001) emotional geographies of teaching. Teachers' emotions are understood through their experiences. The interaction between teachers and learners influences emotional development. The enthusiasm and love that the participants developed through teaching organic chemistry, helped them in achieving positive outcomes. This resonates with Hargreaves's (2001) notion of professional geographies which outlines the interaction between teachers and professional activities. Learning outcomes are achieved when there is an interaction between the teacher and learners regarding the curriculum activities and performance of learners. Through these interactions, teacher emotions develop. Positive emotions develop when there is no gap between the teacher and curriculum activities. Hargreaves (2001) also suggests that teachers develop positive emotions when learners perform well.

4.5.1.2 Frustration and stress

Participants also revealed that they experienced negative emotions when teaching organic chemistry to learners doing technical sciences. Nosipho expressed her frustration with teaching organic chemistry in her technical sciences class. She said: *what frustrates me the most is that organic chemistry is only introduced in grade 12, and for grades ten and 11 there is little chemistry done.* Learners do not have enough background in chemistry from grades ten and 11 which is required to understand organic chemistry better.

Similarly, Maluleka, Ayabonga, and Florence revealed their frustration with teaching organic chemistry as caused by the nature of organic chemistry. They explained that organic chemistry comprises a third component which is based on reactions of organic molecules. Maluleka said that he *always improvises to conduct experiments with learners*. In the same vein, Ayabonga recounted that *organic chemistry is interesting because it is more based on substances learners know and see in their everyday lives, but it is so frustrating to teach reactions without demonstrating for them.* The chemical reactions that have to be taught are easily demonstrated and explained when teachers conduct practical experiments. Furthermore, Maluleka said that his learners learn better if they watch demonstrations or observe what is taught. However, teachers experience frustration and stress when they cannot demonstrate chemical reactions for learners. On that note, Maluleka, Ayabonga, and Florence expressed that their *schools do not have chemicals to conduct experiments.* As a result, learners tend to fail the test on sections covering organic molecule reactions, which makes teachers experience stress. Florence displays in her collage *that if learners fail …this brings stress*. This suggests that teachers become stressed when learners fail or perform poorly and they have to find new ways and strategies of teaching that help to improve learners' results.

Saunders (2013) contends that, if teachers experience negative emotions in their teaching, they are not productive. They add that negative emotions impact negatively on learners' achievement.

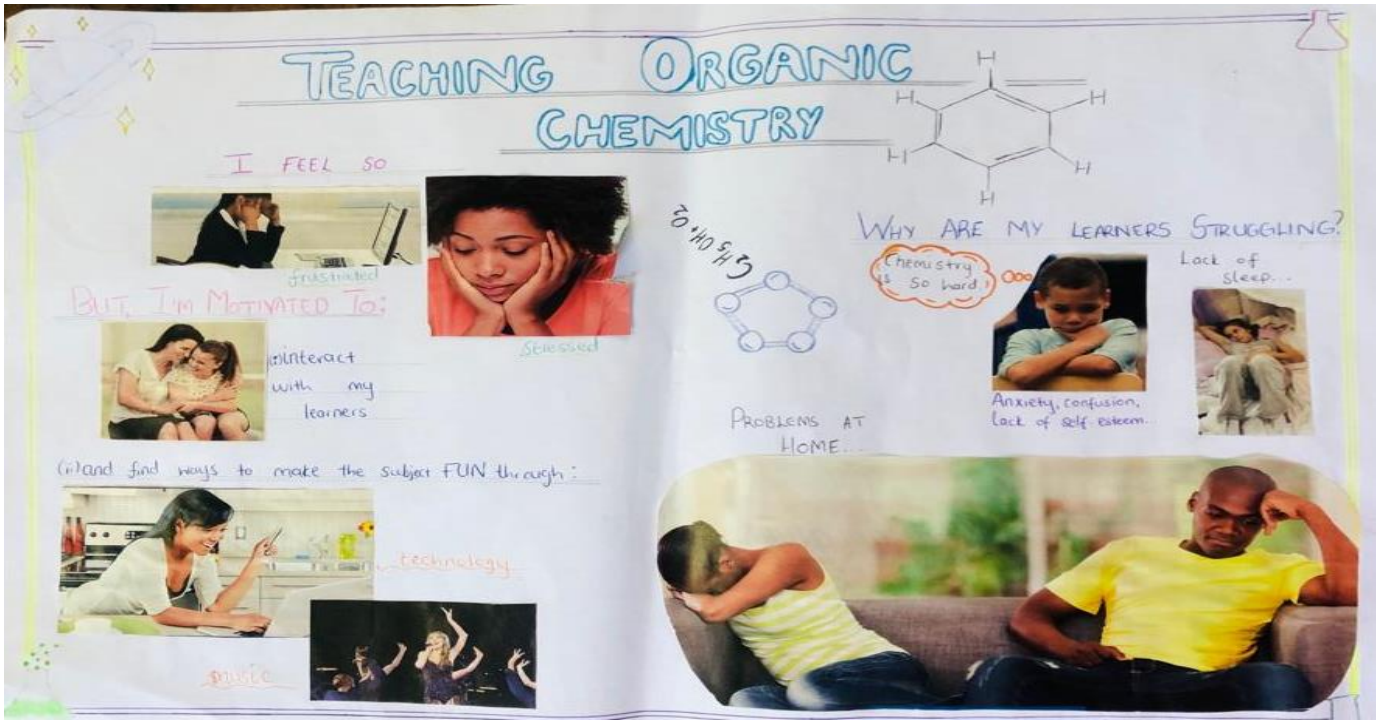

Figure 4.4 Maluleka's collage

Maluleka's collage highlights that teachers experience diverse emotions when teaching organic chemistry. He suggests that teachers find themselves wondering how they could help their learners to perform better in this topic. He shares that family stability seems to affect teachers' well-being, and that the stress from home influences teaching. This means that teachers find it difficult to teach and cope when they are stressed.

The influence of teachers' emotions on their teaching was analysed drawing on Hargreaves's (2001) theory of emotional geographies of teaching. According to Hargreaves (2001), emotional geographies describe the closeness and distance between teachers interact and colleagues, parents, and learners that help to understand the emotions teachers develop. Participants' responses in the semi-structured interviews and collages highlighted that teaching organic chemistry in technical sciences is an emotional practice. This resonates with Hargreaves (2001) who argues that teaching is an emotional practice. For Hargreaves (2001), moral distance describes how teachers develop negative emotions if they do not get support from the school context. Teachers must be supported by their colleagues and learners' parents to develop positive emotions. Moral emotional geographies describe the relationship between teachers and colleagues, parents, and learners. Therefore, if there is a distance in these relationships, the purpose of teaching is lost and teachers develop negative emotions, which have a negative influence on their teaching.

4.5.2 Factors influencing teacher emotions

Participants' collages not only highlighted the diverse and mixed emotions that they experienced when teaching organic chemistry, but also the factors that influenced their mixed emotions. The data generated from participants outlined several factors that contributed to the development of their emotions when teaching organic chemistry. The following factors were highlighted by participants: availability of resources, support from parents and the school management team, and teacher knowledge.

4.5.2.1 Availability of resources.

Maluleka expressed that: *through [his] teaching, [he] discovered that organic chemistry requires lots of chemicals and apparatus so that learners can engage in experiments and be able to see chemicals reacting to consolidate practical and theory.* Therefore, it is a challenge for teachers teaching in a school that lacks equipment and chemicals to conduct experiments. Most of the participants revealed that they experience negative emotions such as frustration and stress which negatively influences their teaching. They elaborated that they are unable to teach organic chemistry effectively and could not perform practical experiments or demonstrations due to a lack of resources.

Florence complained that her *school is located in a deeply rural area and does not have a science laboratory to conduct experiments.* She shared that a lack of resources resulted in her being stressed about finding a teaching strategy to teach her learners the reactions of organic chemistry. Similarly, Nosipho commented that *the nature of organic chemistry requires learners to engage more in practical activities, with the school that [she] is teaching in it becomes difficult because [they] do not have resources.* Participants shared that they had to teach the practical component of organic chemistry in a more theoretical way, due to a lack of resources. This creates confusion for learners and results in misunderstanding chemical reactions in organic chemistry, which in turn results in learners performing poorly in tests and examinations in technical sciences. In the same vein, Ayabonga recounted that he was always stressed when he had to plan for his lessons on organic chemistry. He added: *I try to make it more practical and realistic, and ask learners why they have to learn it since its language is unfamiliar.*

On the other hand, Lulu expressed that her *school is a well-resourced school.* There is a laboratory with all the equipment required to conduct experiments. She always finds it easy to teach all sections of organic chemistry and she experiences positive emotions towards teaching

organic chemistry. She shared that: *My learners enjoy learning chemistry, as a result, most of my learners pass with flying colours.*

Hargreaves (2001) argues that the closeness and interactions between people influence their emotions. Lulu developed positive emotions in teaching organic chemistry because of the support she received from her school and the availability of resources. Hargreaves (2001) outlines that teachers experience happiness when they achieve their purposes. The moral distance described by Hargreaves (2001) is based on the support teachers need to fulfil curriculum needs. If teachers are not granted such support, they fail to achieve what is required by the curriculum. Consequently, this results in the development of negative feelings and emotions. In successful schools, however, people understand one another, and they create an environment that enables them to achieve curriculum needs, which yields positive emotional development. According to Zembylas (2003), emotions are closely linked to teachers' lives, and teaching is an emotional practice. This study reflects that teachers delivered their organic chemistry lessons relative to the way they felt.

4.5.2.2 Support from parents and School Management Team (SMT)

Learners belong to society and they have different backgrounds. Data generated showed that learners' discipline is a major factor that influences teaching. Ayabonga explained that: *after deciding that I will do education as a field of my interest, I realised that the profession required certain qualifications which will enable me to become a better teacher. I then did a Certificate in School Management, which taught me to be able to manage not only the school but also my class.*

The support from parents and the SMT was observed to be crucial for learners' achievement. Lulu said that she *discovered that to avoid the stress that is related to learners' discipline in doing their work [she] should involve their parents*. She further mentioned: *all activities and work that is done in class she gives parents so that they will know what their learners are expected to do.* This saved her energy and effort in pushing learners to do their work and studying to perform better. Such support is inclusive of SMT involvement because if a learner misbehaves in her class, she reports him/her to the SMT, who communicates with parents to address the misbehaviour. Therefore, the support of the SMT and parents contributed to the development of positive emotions in teachers.

Similarly, Ayabonga observed that *when learners perform below expectations and are weak, they become demotivated*. Ayabonga mentioned that he calls parents to encourage his learners

when they become demotivated. With parental support, Ayabonga shared that he did not feel stressed due to the learners' behaviour. In addition, Maluleka *always finds it easy to teach if parents are also involved in their children' education*. Maluleka added: *such support is so valuable.* Likewise, Florence recounted: *what motivated [her] is the type of learners that [she] teaches, if they are eager to learn it becomes easy, and the support from the management and the department.*

This discussion resonates with Hargreaves's (2001) notion of emotional geographies of teaching, which outlines that teachers' emotions are denoted by their experiences. Furthermore, if teachers interact with parents and gain support from them, they develop positive emotions. Hargreaves (2001) outlines that the physical distance between parents and teachers is a significant factor, and that teachers develop positive emotions when they are in close contact with parents. If teachers are physically close to parents, they become aware of the kinds of learners they teach. This enables teachers to understand the kind of challenges learners possess and helps them to deal with these challenges effectively. The physical distance can be referred to lack of or rare contact sessions between the teacher and parents or non-face-to-face communication which is needed to construct emotional understanding and partnership between teachers and parents (Hargreaves, 2001). When teachers are physically close to parents, they become aware of the sociocultural contexts of the learners they teach. Hargreaves (2001) contends that sociocultural distance refers to the teachers being aware of the diversity of learners in their classrooms. If teachers are aware of the cultures and norms of the community where learners come from, then it becomes easier for them to understand the relationship they have with their parents. According to Hargreaves (2001), teachers build better emotional understanding with parents and learners if they have cultural knowledge and can deal effectively with parents' behaviours toward their learners' education.

4.5.2.3 Teacher knowledge

Participants of this study revealed that they went through different teacher training to obtain their qualifications in technical sciences. Some studied towards a Bachelor of Education degree, while others studied engineering and specialised in chemistry, followed by a Postgraduate Certificate in Education. Teachers who studied Engineering found it more interesting to teach organic chemistry, despite the challenges.

Lulu, Maluleka, and Ayabonga revealed that they wanted to become engineers so they began their studies in engineering and specialised in chemistry. They outlined that they always feel

enthusiastic when they have to teach organic chemistry. Maluleka further shared that he *improvises* to teach effectively. Given that these teachers had knowledge about the nature of chemistry, they were better equipped to plan effective lessons and design effective teaching strategies to make their organic chemistry lessons interesting and more effective. Ayabonga mentioned that he planned his lessons to be more realistic and practical. Knowing and understanding concepts taught in organic chemistry made it easier for teachers to design effective teaching strategies.

On the other hand, participants who studied a Bachelor of Education degree experienced difficulty when teaching the practical component of organic chemistry and also failed to improvise or design alternate teaching strategies. Florence elaborated that she struggled to design effective teaching strategies to help her learners learn how to differentiate between the chemical reactions. Florence added that she *ends up theorising even the practical component of organic chemistry.* Similarly, Nosipho explained that she *finds it hard to help [her] learners to understand the reactions that are to be taught in organic chemistry due to lack of resources.* As a result, she watches YouTube videos to help her to teach effectively despite the lack of resources. It is also possible that participants developed negative emotions as a result of the stress involved in designing innovative teaching strategies which required much effort.

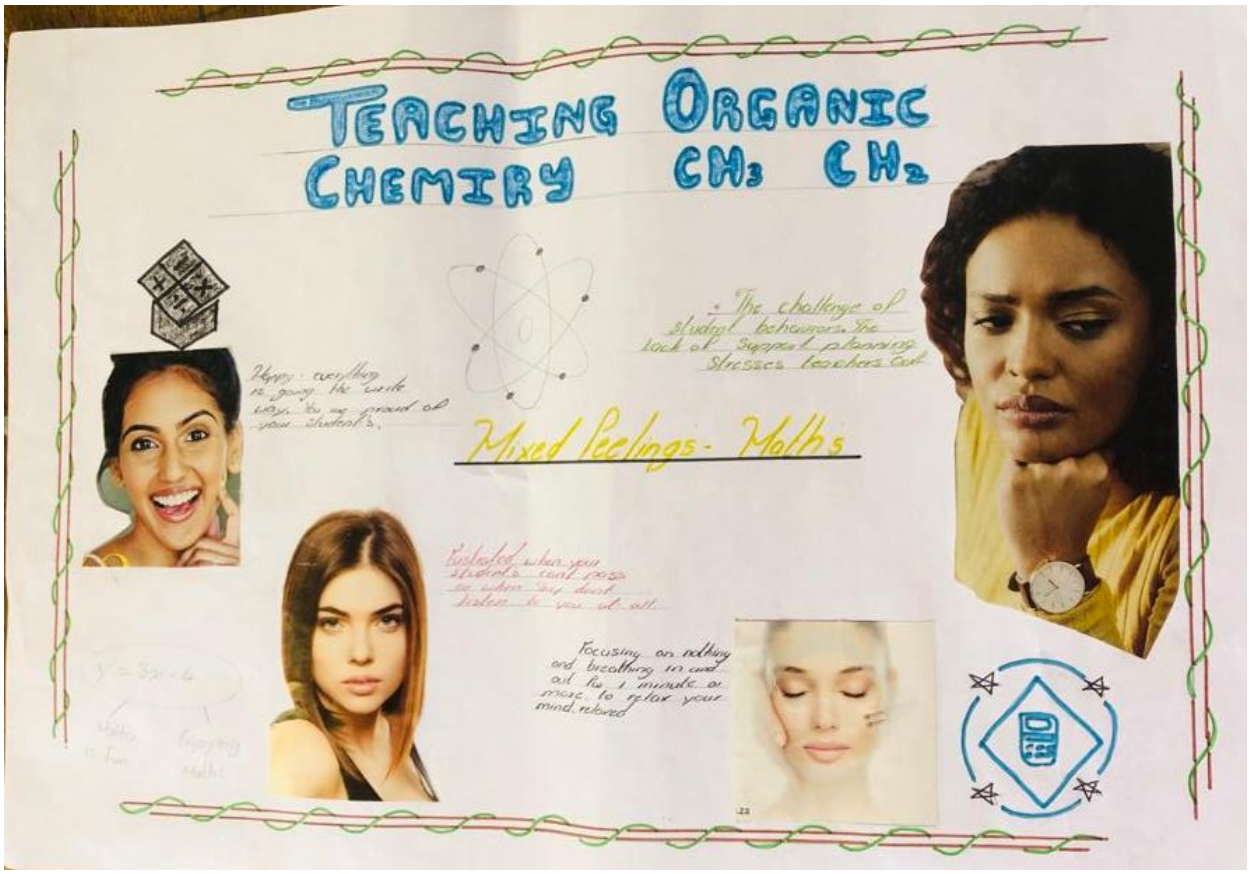

Figure 4.5 Ayabonga's Collage

Ayabonga's collage displayed his mixed feelings and emotions which were caused by the nature of organic chemistry. Participants revealed that teaching technical sciences required logical thinking and drawing from mathematics. Therefore, it was a challenge to teach organic chemistry in technical sciences.

These findings could be analysed drawing on Hargreaves's (2001) notion of professional geographies. According to Hargreaves (2001), professional distance suggests that teachers' emotions are influenced by curriculum activities and the performance of learners. Professional interaction between teacher, their colleagues, and parents develop positive emotions and allows teachers to remain autonomous. Hargreaves (2001) argues that if teachers interact professionally with learners and parents, they become enthusiastic, and this enhances their creativity in teaching. Moreover, when parents are not at a distance and appreciate teachers' effort and work, then teachers develop more positive emotions. Hargreaves (2001) emphasises that teachers need to develop positive emotions by having close relationships with learners, parents, and colleagues. Moreover, teachers need to be able to reduce negative emotions. Teachers improvising to develop effective lessons helps them to reduce negative emotions that

might be brought on by learners' poor performance. The influence of teachers' emotions on their teaching of organic chemistry is discussed in the next section.

4.6 Influence of teacher emotions on teaching of organic chemistry

This section presents and analyses data that addressed research question three:

How do grade 12 technical sciences teachers' emotions influence their teaching of organic chemistry?

The data that was generated revealed that teacher emotions influenced teaching both positively and negatively. Negative teacher emotions were found to have a negative influence on teaching and learners' achievements. Participants indicated that they were passionate about teaching organic chemistry in technical sciences and that learners' achievements were important to them. The following themes emerged from the inductive analysis of the data related to the influence of teachers' emotions on their teaching: mask negative feelings, fall behind with curriculum coverage, and have stress and demands.

4.6.1 Mask negative feelings

The data obtained showed that participants masked their negative emotions by planning interesting lessons. These lessons motivated learners and sharpened their thinking for a better future. It was evident that teachers' emotions influenced their teaching. Data revealed that teachers' positive emotions had a positive influence on their teaching, while negative emotions influenced their teaching negatively. One of the factors that contributed to teachers developing negative emotions was the unavailability of resources. Teachers found themselves unable to perform their duties well because of the lack of resources and equipment at their schools. However, despite the negative emotions that teachers experienced due to a lack of resources, they still strived to do their best to improve learner's achievements.

Ayabonga explained: *All I want is to give my learners a chance to try.* He further stated that *[he] plans [his] lessons to be more realistic and practical for [his] learners to visualise what is taught.* Similarly, Maluleka agreed that: *learners learn better if they see.* Having more practical lessons calls for teachers to be more innovative when it comes to planning their lessons. In the same vein, Nosipho said that *when [she] plans her lessons, [she] uses YouTube to find ideas that will help [her] deliver interesting lessons*. The more interesting lessons become, the more learners enjoy learning about organic chemistry. When learners enjoy

learning about organic chemistry, then teachers develop positive emotions toward teaching which results in learners performing well.

Zembylas (2003) argues that emotions developed by teachers directly impact the decisions they make. Additionally, a teacher's emotions play a significant role not only in the teacher's well-being but also in their ability to function in the classroom. According to Keller et al. (2014), emotions shape how teachers respond to the curriculum. Hanson (2017) emphasises that it is vital to conduct practical activities in sciences, since it enhances learners understanding. In addition, practical activities allow learners to engage actively in learning and increase learners' enjoyment of learning organic chemistry. As teachers plan interesting lessons, their negative emotions become masked.

Hargreaves's (2001) theory of emotional geographies in teaching outlines that if teachers want to function effectively in teaching and learning, they should be aware of distances and closeness which affect their emotions. As teachers are aware of the gap they have between theory and practical activities, they find ways of masking or covering their emotions to increase standards of teaching and learning. The professional distance described by Hargreaves (2001) emphasises that the relationship between teachers, parents, and learners should be based on curriculum activities and learners' performances. In this study, participants revealed that they were willing to mask their negative emotions and planned interesting lessons by prioritising relevant curriculum activities. This enhanced learners' performance and resonates with Hargreaves's (2001) notion of professional distance and moral distance.

4.6.2 Fall behind with curriculum coverage

The participants revealed that due to the negative feelings they experienced when teaching organic chemistry, they found themselves not being able to finish the syllabus in the prescribed time frame. Ayabonga, Florence, and Nosipho elaborated that *there is too much content that is required to be covered in organic chemistry.* It is divided into three components which require a lot of time to cover. Nosipho shared that *the worse part with learners doing technical sciences are more practical inclined*. She added that their concentration span is very low, and they could not speak for more than an hour; they learn better if they solve problems or experiment. Maluleka explained *that organic chemistry has a language that is new to learners, [they] need to teach learners the terms used before getting into the content*. As a result of time required to teach new concepts in organic chemistry and explain chemical reactions, participants revealed that they have little time to revise the sections which resulted in poor performance of learners.

Nosipho mentioned that *it takes learners time to know and differentiate terms and names of molecules, this requires us as teachers to be patient and innovative when it comes to teaching the new content to learners.* On the other hand, Lulu recounted that she *doesn't find [herself] falling behind with the syllabus*. Lulu pointed out that teaching organic chemistry depends on how you feel about it. She added that if one enjoyed teaching it, learners feel enthusiastic about its nature including its vocabulary.

Saunders (2013) asserts that when teachers experience negative emotions, they become unproductive. In addition, the negative emotions impact negatively on learners' achievement. This resonates with Hargreaves's (2001) notion of emotional geographies of teaching, which outlines that the moral distance between teachers, parents, and colleagues plays a vital role in their emotions and teaching. Hargreaves (2001) further contends that the close interaction boosts teachers' morale, and that if teachers' morale is not supported, they tend to experience negative emotions such as stress and anxiety. Hargreaves (2001) adds that teachers become ineffective if they experience negative emotions. He further affirms that when teachers begin teaching, they are encouraged, and their goal is to ensure that they provide the best for their learners. On that note, teacher's difficulties on teaching organic chemistry are also the results of negative emotions they have.

4.6.3 Stress and demands

Some teachers revealed that they were teaching in contexts that resulted in them failing to fulfil their purpose. Having to teach organic chemistry in a school that did not have the relevant equipment to conduct experiments seemed to be a challenge for participants. Participants indicated that this results in having lessons that are not productive. They end up experiencing stress since they fail to accomplish curriculum outcomes.

Nosipho revealed that she finds *it difficult to find the easiest way to teach [her] learners the chemical reactions of organic molecules without having to experiment with learners*. She added that she always experiences stress when she has to teach chemical reactions. Therefore, she feels that she does not do enough for her learners. In the same vein, Ayabonga shared, *once in the workplace the working environment gives a lot of stress and demands a lot as it does and there is no peace, my teaching and my performance as a teacher become affected.* This suggests that the school working environment highly affects teachers' functionality, and teachers find themselves having unproductive lessons that result in stress. Maluleka revealed that the section on organic molecules requires a lot of *improvising*, which demands teachers' time and effort to

plan and design their lessons. Time seems to be a challenge since they still had to do consolidations with learners which enabled them to perform well.

Other participants revealed that the balance between work and family lifestyle does impact their teaching of organic chemistry. Florence mentioned that she *once stayed with [her] stepson, [he] was addicted to drugs and was misbehaving at school*. Florence had to attend her stepsons' cases at school which took a lot of her time out of class. According to Florence, this affected her family as they had no peace and, as a result, she found herself in a state where she could not function well at school. Her pace of teaching decreased, and she had a lot of work to cover. Florence explained: *at that time I could not focus on my work since I had that stress, I would come to my room and sleep without preparing for my lessons. My lessons did not go well and actually were not productive because I had no direction because of stress, such stresses affected me physically and emotionally*. This resonates with an observation made by Maluleka that*: school is an extension of family, sometimes family life and lifestyle of family do affect teaching*. Maluleka further shared that *if the family life is balanced with work life then you find it easy to cope with the two.*

This could be analysed drawing on Hargreaves's (2001) theory of emotional geographies of teaching, which outlines that if teachers are aware of these factors, they would know how to interact with the factors affecting their well-being. The physical distance of teachers from learners, parents, or colleagues, according to Hargreaves (2001), should be based on promoting positive emotions. In that sense, teachers should communicate with colleagues in a supportive manner and avoid distance where the communication might end up affecting mental health. This study highlighted that colleagues might affect teachers' well-being positively or negatively. However, Hargreaves (2001) emphasises that the relationship should remain professional to avoid negative emotions that might develop. All other forms of distance, namely, moral, sociocultural, professional, and political should be maintained based on the purpose of achieving curriculum needs for teachers to develop positive emotions.

4.7 Conclusion

This chapter presented and analysed the data that was generated through semi-structured interviews and collages. The data was generated from five participants who had been teaching grade 12 technical sciences for more than five years. Two participants were from the Ugu district, while three participants were from the Harry Gwala district. Participants' narratives were constructed and their responses analysed inductively. Thematic analysis was used first to

code the data into categories, and then group similar codes or patterns into themes. Gu and Day's (2007) three dimensions of identity and Hargreaves's (2001) theory of emotional geographies of teaching were used as the conceptual framework to analyse and interpret the themes.

Analysis of the narratives revealed that teachers have different personal and professional identities that influence how they teach in the classroom. Their diverse identities were used to make sense of how the teachers view themselves when teaching organic chemistry in technical science classes. Teachers displayed the following identities: teaching as a calling, teacher as a role model, and teacher as a lifelong learner.

The analysed narratives also showed that teachers experienced mixed emotions when teaching organic chemistry in technical sciences. The positive emotions that they experienced included enthusiasm and love. These positive emotions had a positive influence on their technical sciences teaching, hence learners performed very well when teachers taught with positive emotions. Negative emotions mentioned were frustration and stress, which led to learners performing poorly. In addition, the participants highlighted the following factors that influenced their emotions: availability of resources in their schools, teacher knowledge of organic chemistry, and parental involvement and support from the school management team.

Negative emotions of teachers influenced their teaching negatively. The negative influence was on the achievement of curriculum outcomes, masking negative emotions, and stress from family and work environment. The following chapter summarises the findings, and outlines the conclusion, as well as recommendations for further research.

Chapter 5

Discussion of Key Findings and Recommendations

5.1 Introduction.

This study aimed to explore the identities and emotions of teachers teaching organic chemistry in grade 12 technical sciences classes. It further examined how teacher identities and emotions influence their teaching of organic chemistry in technical sciences grade 12 classes. The purpose of this chapter is to discuss the key findings of this study in relation to the three research questions. This study examined the narratives of five teachers, two located in the Ugu district and three located in the Harry Gwala district. The participants of this study were given pseudonyms to protect their identities. Data for this study was generated using semi-structured interviews and collages. The data was generated to address three research questions:

1. What do grade 12 technical sciences teachers' stories tell us about their personal and professional identities and their teaching of organic chemistry?

2. What emotions do grade 12 technical sciences teachers experience when teaching organic chemistry?

3. How do grade 12 technical sciences teachers' emotions influence their teaching of organic chemistry?

Data was analysed using Gu and Day's (2007) three dimensions of teacher identity and Hargreaves's (2001) notion of emotional geographies of teaching. The research questions were analysed inductively by highlighting themes that emerged from the data analysis. The research study was presented in five chapters.

Chapter one outlined the purpose of this study and provided the background and rationale of the study. The research questions were introduced as well and an overview of the literature review, the conceptual framework, and the research methodology employed in this study was outlined. The conclusion of this chapter was the summary of the structure of this thesis.

Chapter two integrated the literature review with the conceptual framework employed in this study. The literature review engaged arguments from different authors on teachers' professional and personal identities. Teacher emotions were also reviewed as discussed by different authors. This chapter also incorporated the teaching of organic chemistry, by considering the nature of technical sciences and the nature of organic chemistry. The chapter

concluded with an overview of the conceptual framework of Gu and Day's (2007) three dimensions of teacher identity (professional, situated, and personal) and Hargreaves's (2001) notion of five emotional geographies (physical, moral, socio-cultural, professional and political).

Chapter three discussed the methodological approach used in this study. This qualitative research study was located within an interpretive paradigm. The purposive sampling strategy was employed to select five participants teaching grade 12 technical sciences in the Ugu and Harry Gwala districts. Data was generated using semi-structured interviews and collages. These data generation instruments allowed a deeper understanding of participants' identities and emotions. The issues of trustworthiness and reliability of the study were outlined by the chapter. The chapter concluded with a discussion of ethical issues considered in this study.

Chapter four presented and analysed data that was generated by semi-structured interviews and collages. The first research question was analysed inductively. It was interpreted using Gu and Day's (2007) three dimensions of identity, namely, the professional, situated, and personal dimensions. Participants were found to have diverse identities. The second research question was analysed inductively and showed that participants had mixed feelings when teaching organic chemistry. Research question two was underpinned by Hargreaves's (2001) emotional geographies of teaching. The third research question was also analysed inductively and outlined the influence of teacher emotions on their teaching. It was also supported by Hargreaves's (2001) emotional geographies of teaching. This chapter concluded with a summary of teacher identities and emotions and their influence on teaching organic chemistry.

Chapter five concludes this study by discussing the findings and how they addressed the research questions. The responses and discussions are presented according to the research questions. The key findings that addressed Gu and Day's (2007) personal, professional, and situated dimensions of teacher identities are discussed: teaching as a calling, teacher as a lifelong learner, teacher as a role model, and teacher as a motivator. The mixed emotions that influenced teaching were also presented and the factors that affected emotions were discussed, including the influence of teacher emotions towards teaching organic chemistry in technical sciences grade 12 classes. This chapter concludes with the strengths and limitations of this study followed by recommendations for further research.

5.2 Discussion of key findings

Beijuard et al. (2004) assert that teachers possess different identities which are closely linked to their context of interaction. Data generated from the narratives of teachers teaching grade 12 technical sciences in this study showed that teacher identities were formed through their context of interaction.

5.3 Research Question One

The following findings were derived to respond to research question one: *What do grade 12 technical sciences teachers' stories tell us about their personal and professional identities and their teaching of organic chemistry?*

The grade 12 technical sciences teacher narratives revealed that teachers have the following diverse identities: teaching as a calling, teachers as lifelong learners, teachers as role models, and teachers as motivators. The discussion of these diverse identities follows.

5.3.1. Teaching as a calling

Zembylas (2015) finds that teacher identity can be viewed as a perspective that teachers develop based on themselves, their learners, their learner's learning, and methods of instruction, curriculum, and school as a social institution. Correspondingly, teacher identity is the source of particular practices in classrooms and schools, as well as the situation of thoughts, attitudes, emotions, beliefs, and values (Zembylas, 2003). Similarly, teachers in this study display that teaching technical sciences requires one to be passionate about teaching. In addition, teachers felt that to be able to cope in a school environment without enough teaching equipment, they need to *improvise*. Their attitude of viewing teaching as a calling enables them to be resilient and always strive for their best when it comes to teaching.

Data showed that teachers found that teaching was a calling to them when they started interacting with learners. Similarly, Rodrigues and Mogarro (2019) outlines that the changes in the education setting reform teachers' work, which makes it vital for teachers to understand where they stand in the current educational context. On that note, the practices that teachers engaged in the classroom revealed their position with the profession. Beijaard et al. (2004) assert that teachers construct their identity through their previous school experience or in professional training programmes. In the same way, Ayabonga said he never saw himself as a teacher but found that teaching was a calling to him when he started interacting with learners of the school where he was providing community service.

Zhu et al. (2020) denote that professional identities display the status of teachers as they are practicing teaching. These identities are how they see themselves and who they are in the teaching profession. Organic chemistry was found by participants as challenging to teach, because of the nature of the learners doing technical sciences as well as the school context in which that they had to teach. However, teachers who viewed teaching as a calling found it easy to cope in their environment because they always strived to achieve the curriculum goals. According to Beijaard et al. (2004) . , teacher's professional identity formation is a process of negotiation between the individual and the contextual factors. Participants acknowledged their profession and were able to embrace the challenges that they faced in their contexts.

5.3.2 Teacher as a lifelong learner

Ghanizadeh and Ostad (2016) maintain that professional advancement and teachers' awareness of change are shaped by their professional identity. Similarly, Beijaard (2018) assert that support is a contributing factor to the development of a professional identity and that through participating actively in development activities, one's professional identity becomes strengthened. Correspondingly, the participants' narratives revealed that being a teacher requires them to be knowledgeable. Maluleka even denoted that *a teacher never stops learning*. It was revealed that the changes that occur in the curriculum requires that teachers be creative to achieve its objective. Participants revealed that there are content workshops which are organised by the DBE and are held yearly. Participants confirmed that they attended these workshops because they believed that interacting with other teachers from different contexts advanced their teaching.

Zhu et al. (2020) maintain that if teachers can overcome the changes that take place in South Africa, their professional identities are strong. Similarly, the narratives of teachers revealed that participants were trained to teach physical sciences, however, when technical sciences was introduced, they were required to teach technical sciences. Participants did not experience challenges in switching from teaching organic chemistry to teaching technical sciences because they were always willing to learn. They were motivated to attend workshops training them on how they should teach the same topics in different subjects.

Teacher narratives also revealed that in their first year of teaching, participants did not have enough confidence to teach organic chemistry. They explained that they attended workshops where they gained knowledge from teachers who had been teaching for many years. According

to Day (2013) teachers need to do self-introspection, such as this, as it influences their professional identity.

5.3.3 Teacher as a role model

Chen and Mensah (2018) assert that identities are built or socially constructed in a community of practice and an individual's identity is subjective to how the person is recognised in the social context. The narratives showed that participants were raised in societies where teachers were valued and respected. Some chose to be teachers because they wanted to be respected and valued. Similarly, Parsons and Bailey (2019) argue that the sociocultural setting influences teacher identity. Avraamidou (2014) also asserts that teachers' personal history and their previous experiences shape their identities.

Participants' teaching of organic chemistry was influenced by how they viewed themselves in the profession of teaching. The narratives highlighted that teachers believed that their influence on learners was valuable. In addition, teachers, when teaching organic chemistry, viewed themselves as people who build learners' futures. They saw themselves as the 'way maker' for learners. Having such belief in their profession enabled teachers to survive the challenges they encountered when teaching organic chemistry. Beijaard et al. (2004) . emphasise that teachers are raised in communities where their actions and roles are monitored, and when they engage as teachers, what was communicated in the community influences their identity. Similarly, teachers' narratives revealed that when teachers teach organic chemistry, they wanted to leave a good mark on learners and they even said that they wanted to be always remembered as good teachers. With regard to classroom practices, teachers planned interesting and effective lessons not only to equip learners to pass, but also for learners to use what was taught to better their societies.

5.3.4 Teacher as a motivator

Saleme et al. (2020) assert that organic chemistry is one of the topics that learners find difficult to learn. According to Dwyer (2017), this results in learners developing a negative attitude towards learning organic chemistry. The narratives of teachers indicated that teachers believe that every learner can do technical sciences. Furthermore, teachers needed to create a positive environment that would motivate learners not to view organic chemistry as a difficult topic.

Parsons and Bailey (2019) contend that teacher identity is developed through teacher experiences in a context. The narratives of participants suggested that some teachers were misguided during their schooling. They believed that sciences are difficult and not everyone

can do it. As a result, they viewed themselves as professionals who should motivate learners to achieve good marks so that they could further their studies in careers of scarce skills. Participants viewed education as a tool to overcome poverty in society, and they viewed organic chemistry as a practical topic. Hence, they motivated learners to better understand it to change society.

5.4 Research question two

The following findings were discussed in response to research question two: *What emotions do grade 12 technical sciences teachers experience when teaching organic chemistry?*

This study revealed that when teachers teach organic chemistry in technical sciences classes, they experienced mixed emotions, and there were factors that affected these emotions.

5.4.1 Mixed emotions

Teacher narratives indicated that teachers experienced both positive and negative emotions when they taught organic chemistry in technical sciences classes. The positive emotions experienced were enthusiasm and love, and the negative emotions were frustration and stress.

5.4.1.1 Enthusiasm and love

According to Hargreaves (1998) , emotions are at the core of teaching. Emotions shape or direct how teachers react. The teacher narratives of this study revealed that organic chemistry is divided into three sub-topics and that teachers experienced different emotions when teaching or addressing them. Dwyer (2017) outlines that organic chemistry has three parts the macroscopic (the visible part), sub-microscopic (the invisible part), and a symbolic part (chemical symbols and reactions). The participants' narratives highlighted that teachers experienced enthusiasm and love when they had to introduce organic chemistry, which they considered the visible part. This macroscopic part consists of the concept and vocabulary of organic chemistry. Since organic chemistry was new to learners when they engaged in it, teachers became enthusiastic because they already knew that this was the easiest part in which learners usually get good marks.

Participants displayed that they loved organic chemistry and were always willing to teach it. Their love for organic chemistry overlapped with learners' love for the topic. Frenzel, Goetz, and Stockinger (2024)emphasise that emotions are socially constructed and personally enacted to achieve goals. Participants revealed that their love of the first part of organic chemistry was developed by their previous experiences. They observed that learners always passed the first

part of organic chemistry, which resulted in teachers being positive about teaching the first part. According to Keller et al. (2014), emotions influence how one responds to a current situation. Teacher narratives also revealed that organic chemistry was their favourite topic in chemistry, hence they felt enthusiastic about teaching it.

5.4.1.2 Frustration and stress

Wu and Chen (2017) found that teachers experienced both negative and positive emotions in teaching. The participants revealed that they also experienced negative emotions when teaching organic chemistry. Keller et al. (2014) emphasise that emotions instantly join mental, reasoning, phenomenological, and social dimensions of situations. As participants had taught for more than five years, they observed that, in most instances, learners failed the symbolic part of organic chemistry. They noted that even learners who were viewed as highflyers had challenges with the symbolic part which is based on chemical reactions.

Day et al. (2006) maintain that teachers experience a multiplicity of negative emotions. Furthermore, some of these emotions occur when their long-held principles are challenged and trust and respect from learners and parents alike break down. On the other hand, Manasia et al. (2020) maintain that negative emotions are developed by the impact of the educational environment and learners' emotions. In the study, teachers found it challenging to design creative ways of teaching chemical reactions to learners, which resulted in stress. Participants mentioned that learners who were doing technical sciences found it easy to learn by seeing and learning about practical content. The part that is invisible in organic chemistry was found to be difficult for learners since they could not relate to it. This resulted in poor performance of learners which accumulated negative emotions for teachers.

5.4.2 Factors affecting teacher emotions

Participants revealed that they experienced positive and negative emotions when teaching organic chemistry in technical sciences classes. Their narratives highlighted the following factors that influenced their emotions: availability of resources, support from parents and the school management team (SMT), and teacher knowledge.

5.4.2.1 Availability of resources

Hanson (2017) emphasises that it is vital to conduct practical activities for learners since it increased learners' understanding. Similarly, Gibbons, and Raker (2019) contend that practical activities allow learners to engage actively in learning and increase learners' enjoyment of learning organic chemistry. However, Maluleka, throughout his teaching experience, found

that organic chemistry required a lot of chemicals to be effectively taught. The narratives of participants indicated that most of the schools did not have science laboratories, and, even the ones that did have laboratories, often did not have chemicals. Similarly, Hanson (2017) found that some schools have challenges conducting practical activities because of a lack of equipment and science materials. This developed negative feelings for teachers because they were unable to fulfil their purpose.

The emotions impact teacher professional development (Saunders, 2013). The participants revealed that the invisible part of organic chemistry required practical activities. A teacher who had enough resources to conduct practical activities found it easy to teach the invisible part, and learners easily understood. Hence their performance was good in all aspects of organic chemistry. In contrast, participants who had no resources failed to teach the invisible part practically and their learners found it irrelevant and were demotivated to learn it. This resulted in the learners' poor performance in this section. Participants mentioned that they focused more on the theory aspect to help learners understand the reactions. As a result, there was a lot of content to cover which resulted in teachers developing negative emotions. According to Manasia et al. (2020), when teachers are incapable of teaching in the way in which they would like to, they experience negative emotions.

5.4.2.2 Parents and SMT support

The emotions of participants were also affected by support from parents and SMT. The narratives of participants revealed that if parents and SMT were involved in learning, teaching became easier. Learners performed very well if parents were aware of all the activities in which they were engaging. If parents were aware of the topics being taught, and when learners would write assessments, however, they could support and motivate them to study. According to Saunders (2013), teachers work should not be isolated from social interactions that influence emotions.

According to Zembylas (2015), emotions have an influence on teaching and learning and they assist teachers in constructing solid relationships with learners. Congruently, Manasia et al. (2020) argue that if teachers develop good relationships with learners, they find more joy in doing their work in the teaching profession. When teachers experience happiness in their teaching, the environment becomes positive. Hence, Chen et al. (2020) assert that in a positive working environment, teachers experience positive emotions. Participants also revealed that misbehaving learners disturb learning, and that reporting these learners to SMT and parents

assisted because learners were afraid of SMT and their parents. Such methods of discipline created a positive working environment. Richards (2020) emphasises that the emotions of teachers are essential not only for teachers' well-being but also for them to function in their classrooms. Edmonds (2020) assert that if the school climate is conducive and involves parents and good relationships between learners and teachers, then learning outcomes become positive.

5.4.2.3 Teacher knowledge

A lack of content knowledge of a subject leads to teachers becoming frustrated and uncomfortable teaching it (Richards, 2020). Furthermore, without content knowledge, teachers end up losing confidence and failing to teach learners effectively. They worry about being unable to answer questions posed by learners and are scared to make mistakes. Narratives revealed that in their first year of teaching, participants were not aware of the challenges that they would face when teaching organic chemistry. Nosipho stated that during her first year, there were subtopics that she was not confident enough to teach. Nosipho was not confident with teaching such topics until she attended a workshop where she gained enough knowledge. On that note, Beijaard et al. (2000) acknowledge that teachers who have experience have more expert knowledge in the subject that is taught. As participants gained experience, they became aware of parts of organic chemistry that learners find difficult and found ways of dealing with such challenges.

Richards (2020) asserts that the emotional state of learners in the classroom depends on teachers' emotions and how teachers view themselves personally and professionally. The participants revealed that it was very difficult to achieve learning outcomes if they did not have experience in teaching a subject. The narratives showed that when teachers were initially introduced to teaching technical sciences, it was very challenging for them to teach organic chemistry since they did not know which aspects should be emphasised. Maluleka confirmed that he taught organic chemistry in physical sciences for many years, but when he had to switch to teaching it in technical sciences, it felt like a new topic. Before teaching technical scinces classes, he had to check the examination guidelines to check on what should be taught. Glazzard and Rose (2019) contend that teacher knowledge seems to affect teachers' mental health because teachers become stressed when they lack knowledge of what should be taught.

5.5 Research question three

The following finding was discussed in response to research question three: *How do grade 12 technical sciences teachers' emotions influence their teaching of organic chemistry?*

This study found that when teachers teach organic chemistry in technical sciences, they strive for the best lessons. Teachers mask negative feelings by planning interesting lessons, fall behind with the curriculum, and experience stress and demands.

5.5.1 Mask negative emotions

Edmonds (2020) assert that if the school climate is conducive and involves parents, a good relationship between learners and teachers develops and learning outcomes can be achieved. In this study, teacher narratives revealed that teachers masked negative emotions to enable them to achieve positive outcomes. Richards (2020) argue that if teachers at schools experience an increase in classroom demands and poor working conditions, they become fatigued and stressed. Similarly, Glazzard and Rose (2019) emphasise that when teachers are stressed, they lose their confidence and fail to work effectively with learners. Theron (2016) studied factors that affect teachers' resilience, their ability to develop their strengths, and their well-being. It was evident from teacher narratives that they planned interesting lessons to cover their negative emotions, hence, enabling learners to gain an in-depth understanding of organic chemistry. Most teachers were teaching in schools with no equipment to conduct practical activities. This was a major factor that influenced teachers' negative emotions.

Chen (2016) contends that the smooth delivery of lessons depends on the teacher's emotions. Correspondingly, Richards (2020) asserts that teacher emotions directly influence learner achievement. Teachers revealed that through their experiences they found that their negative emotions towards teaching the third part of organic chemistry, reactions of organic molecules, influenced learner performance. Florence mentioned that her learners used to achieve poor results in organic chemistry reactions until she improved her approach to teaching it. The interesting lessons in organic chemistry involved engaging in YouTube videos, finding practical examples that learners know from society, and conducting practical activities. It was evident that learners understood better when they observed what was taught during lessons. The narratives demonstrated that teachers were satisfied with their job if learners were taught for understanding rather than passing. Therefore, the lessons planned encouraged learners to gain in-depth knowledge so that they performed well.

5.5.2 Falling behind with curriculum

The narratives of participants revealed that if teachers experienced negative emotions about teaching a topic, their learners also experienced negative emotions towards that topic, resulting in more time taken to finish the topic. Similarly, Gibbons and Raker (2019) assert that teacher

emotions contribute to academic success because they determine the enthusiasm of learners to learn new content. Teachers who are teaching in schools where the environment is not conducive in terms of resources, experience negative emotions when they teach organic chemistry because they cannot conduct the practical activities required to cover some aspects of organic chemistry. According to the annual teaching plan, there are time frames that indicate the time that should be taken to cover a topic, however, teachers' emotions tend to influence the time taken to complete the workload.

Teachers indicated that there is a lot of content that needs to be covered under organic chemistry. Having to teach the topic in technical sciences classes where learners have little background in chemistry is a challenge on its own. Teachers try their best to assist learners in understanding concepts in organic chemistry, even though they find it more challenging and time-consuming. According to Black and Deci (2000), if the teacher is supportive of learners, learners increase their self-regulation and interest in learning organic chemistry. The support offered by teachers requires a lot of time as a result of the large content to be covered. Saleme et al. (2020) found that learners' understanding of concepts, methods used by teachers, and poor learner enthusiasm and engagement influenced teacher emotions. Such emotions influence the time taken to complete topics indicated in the annual teaching plan.

5.5.3 Stress and demands

Teacher narratives revealed that teachers experienced negative emotions which negatively influenced the teaching of organic chemistry in technical sciences classes. The emotions from family and school contexts were found to affect teachers the most. Maluleka described the school as an extension of family. He stated that home interactions affect teacher emotions. Congruently, Zembylas (2005) contends that the emotions that teachers experience also come from the principles and beliefs they learn from their families or communities. Participants revealed that their emotions drove their mood and classroom practices. Similarly, Keller et al. (2014) asserts that emotions are crucial for teachers because they influence how they behave. In this study, the emotions from families involved financial status, family sickness, or well-being. Participants revealed that they found it difficult to teach if the situation at home was not good. This included family business not going well, sick family members, or no peace at home. When teachers experienced challenges at home, they articulated that they did not go to school or, if they did go to work, they sometimes did not teach, or taught ineffectively.

Teachers' narratives revealed that negative emotions developed from home or the community resulted in stress which made them ineffective in the classroom. According to Yazan (2018), teacher emotions change based on experiences, and, as a result, teachers' practices and interactions are affected. Teachers who are aware of the negative influence of their negative emotions, know that whenever they experience negative emotions at home, they must allow themselves to deal with them. Other teachers take leave and try to overcome their challenges at home. Once they return to work, they have to cover the content they are behind on, which is sometimes stressful. Richards (2020) asserts that it is vital for teachers to be aware of their emotions, so that they are able to manage the emotional dimension of teaching and learning.

Zembylas (2003) asserts that by exploring their own emotions, teachers are able to recall the emotional experiences that occurred in their lives which they have forgotten. He maintains that reflecting on one's emotions "is a powerful tool to enrich knowledge" (Zembylas, 2003, p.90). Gu and Day (2007) contend that when teachers begin teaching, they are internally motivated, and their goal is to ensure that they provide the best for their learners. Richards (2020) argues that when teachers work in an environment where there are limited resources, they experience negative emotions that prevent them from having an ideal professional identity.

5.6 Limitations of the study

This study examined the narratives of five teachers teaching technical sciences in grade 12. Two of the participants were from the Ugu district and three were from the Harry Gwala district. All participants in this study were not trained to teach technical sciences since the subject was newly introduced and was assigned to be taught by teachers trained to teach physical sciences. The findings of this study cannot be generalised to other contexts.

Another limitation was that the participants were teaching grade 12 learners and the data generation was conducted while participants were very busy with assessments and revision. There were cases where I had to follow up using phone calls and emails, because of network and load shedding, and some information was not explained in detail.

5.7 Recommendations for further research

This study recommends that the Department of Education plan workshops to train teachers to teach technical sciences, as it is a new subject that teachers were not trained to teach. The training should consider the contextual factors of schools that might influence the teaching of the subject. Furthermore, the Department of Education should provide opportunities for teachers to discuss their identities and emotions in relation to teaching technical sciences. In

addition, the Department of Education must ensure that, when a new subject is introduced, schools are provided with the necessary resources to avoid negative emotions which may negatively influence teaching and learning.

In addition, this study recommends that school management teams should encourage a positive working environment in schools. The findings of this study showed that if teachers are not able to fulfil their purpose, they tend to develop negative feelings towards their work, which results in learners' poor performance.

5.8 Conclusion

The purpose of this study was to examine the identities and emotions of teachers teaching grade 12 technical sciences. Also, this study aimed to explore how teacher identities and emotions influenced the teaching of organic chemistry to grade 12 technical sciences learners. This chapter highlighted the link between the previous chapters and integrated them, leading to the completeness of this study. The study found that teachers teaching technical sciences have different identities and mixed emotions when teaching organic chemistry. Teacher emotions were influenced by the availability of resources, parental and school management team support, and teacher knowledge. The findings of this study showed that teacher identity helps teachers to strive for the best for their learners and be able to overcome the contextual issues that hinder them from delivering effective lessons in organic chemistry.

Lastly, the study found that teacher emotions influence the teaching of organic chemistry in technical sciences classes. When teachers experience positive emotions towards teaching organic chemistry, learners also feel eager and enthusiastic to learn. As a result, learners perform well. However, when teachers experience negative emotions towards teaching organic chemistry, they do not feel confident to teach. Thus, learners feel demotivated and discouraged to learn, resulting in poor performance of learners.

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APPENDIX 1: LETTER TO THE PRINCIPAL

[redacted]

[redacted]

06/02/2023

Ixopo

3276

Dear Sir/Madam

My name is Nomthandazo. N. Fakude (Student No.211511889) a Master of Education (MEd) student in the School of Education at the University of KwaZulu-Natal (Pietermaritzburg campus). As part of the requirement for this degree, I am required to conduct a research project. The title of my research study is: Exploring Teacher Identities and Emotions in the Teaching of Organic Chemistry in Grade 12 Technical Sciences.

The purpose of this research study is to explore how teacher identities and emotions influence the teaching of Organic Chemistry in Grade 12 Technical Sciences. I request your assistance in this research project by being granted permission to conduct my study in your school. This study is expected to use participants who are teachers in your school and will involve the following procedures. Participants will be required to participate in semi-structured interviews that are expected to last between 20 to 40 minutes at a time suitable to them which will not disturb teaching and learning. Follow-up interviews may be conducted if necessary. Each interview will be voice-recorded. Participants will also be requested to design a collage. The duration of their participation if they choose to participate and remain in the study is expected to be 4-6 weeks.

This study will not involve any risks and/or discomfort for the school and participants. Also, the study will not provide direct benefits for the school or participants.

In the event of any problems or concerns/questions you may contact me, my supervisor or the UKZN Humanities & Social Sciences Research Ethics Committee, contact details as follows:

My contact number is Cell: [redacted]

Email: f[redacted]

Supervisor

Dr J. Naidoo Email address: naidooj@ukzn.ac.za

Telephone 033 260 5867

UKZN Research Office

Research Office, Westville Campus

Govan Mbeki Building

Private Bag X 54001

Durban

4000

KwaZulu-Natal, SOUTH AFRICA

Tel: 27 31 2604557- Fax: 27 31 2604609

Email: HSSREC@ukzn.ac.za

Participation in this research study is voluntary and participants may withdraw participation at any point. In the event of refusal/withdrawal of participation the participants will not be penalised. There are no consequences for participants who withdraw from the study.

No costs will be incurred by participants as a result of participation in the study and there are no incentives or reimbursements for participation in the study.

All names of schools and participants will be changed and pseudonyms will be used so that schools and participants remain anonymous. Information provided by participants will remain confidential and will not be shared with anyone else. Data generated through semi-structured interviews and collage will be stored in my supervisor's office (Room 47), at the School of Education, Pietermaritzburg campus for five years, and thereafter be destroyed.

Thank you for your cooperation.

Yours in Education

NN Fakude

DECLARATION OF CONSENT

I_____ (Full names of the school principal) have been informed about the study entitled: Exploring Teacher Identities and Emotions in the Teaching of Organic Chemistry in Grade 12 Technical Sciences by Nomthandazo Fakude

I understand the purpose and procedures of the study.

_____ _____

SIGNATURE OF PRINCIPAL DATE

APPENDIX 2: LETTER TO PARTICIPANTS

[redacted]

[redacted]

Ixopo

3276

06/02/2023

Dear participant

REQUEST FOR PARTICIPATION IN RESEARCH PROJECT

My name is Nomthandazo N Fakude (Student No. 211511889) a Master of Education (MEd) student in the School of Education at the University of KwaZulu-Natal (Pietermaritzburg campus). As part of the requirement for this degree, I am required to conduct a research project. I request your participation in this research study. The title of my study is: Exploring Teacher Identities and Emotions in the Teaching of Organic Chemistry in Grade 12 Technical Sciences.

The purpose of this research study is to explore how teacher identities and emotions influence the teaching of Organic Chemistry in Grade 12 Technical Sciences. This study is expected to use five participants and will involve the following procedures. As participants, teachers will be requested to participate in semi-structured interviews that are expected to last between 20 to 40 minutes at a time suitable to them which will not disturb teaching and learning. Follow-up interviews may be conducted if necessary. Each interview will be voice-recorded. Participants will also be requested to design a collage. The duration of your participation, if you choose to participate and remain in the study, is expected to be 4-6 weeks.

This study will not involve any risks and/or discomfort to teachers. Also, the study will not provide direct benefits for teachers.

In the event of any problems or concerns/questions you may contact me, my supervisor or the UKZN Humanities & Social Sciences Research Ethics Committee, contact details as follows:

My contact number is Cell: [redacted]

Email: [redacted]

Supervisor

My supervisor is Dr J. Naidoo who is located at the School of Education, Pietermaritzburg campus of University of KwaZulu-Natal.

Telephone 033 260 5867, Email address: naidooj@ukzn.ac.za

UKZN Research Office

Research Office, Westville Campus

Govan Mbeki Building

Private Bag X 54001

Durban

4000

KwaZulu-Natal, SOUTH AFRICA

Tel: 27 31 2604557- Fax: 27 31 2604609

Email: HSSREC@ukzn.ac.za

Participation in this research study is voluntary and you may withdraw participation at any point. In the event of refusal/withdrawal of participation you will not be penalised. There are no consequences for participants if they withdraw from the study.

No costs will be incurred by teachers as a result of participation in the study and there are no incentives or reimbursements for participation in the study.

All names of schools and participants will be changed and pseudonyms will be used so that schools and participants remain anonymous. Information provided by learners will remain confidential and will not be shared with anyone else. Data generated through semi-structured interviews and collage will be stored in my supervisor's office (Room 47), at the School of Education, Pietermaritzburg campus for five years, and thereafter be destroyed.

Thank you for your cooperation.

Yours in Education

NN Fakude

DECLARATION OF CONSENT

I, _____ (Name of participant) have been informed about the study entitled: Exploring Teacher Identities and Emotions in the Teaching of Organic Chemistry in Grade 12 Technical Sciences by Nomthandazo Fakude.

I understand the purpose and procedures of the study.

I have been given an opportunity to ask questions about the study and have had answers to my satisfaction.

I declare that my participation in this study is entirely voluntary and that I may withdraw at any time without affecting any of the benefits that I usually am entitled to.

If I have any further questions/concerns or queries related to the study I understand that I may contact the researcher at (provide details).

If I have any questions or concerns about my rights as a study participant, or if I am concerned about an aspect of the study or the researchers then I may contact:

HUMANITIES & SOCIAL SCIENCES RESEARCH ETHICS ADMINISTRATION

Research Office, Westville Campus

Govan Mbeki Building

Private Bag X 54001

Durban

4000

KwaZulu-Natal, SOUTH AFRICA

Tel: 27 31 2604557 - Fax: 27 31 2604609

Email: HSSREC@ukzn.ac.za

Additional consent, where applicable

I hereby provide consent to:

Participate in semi-structured, narrative interview YES / NO

Audio-record my interview YES / NO

Design a collage YES / NO

_____ _____

Signature of Participant Date

APPENDIX 3: DATA GENERATION INSTRUMENTS

Semi-structured interview schedule

This study is guided by 3 research questions:

1. What do grade 12 technical sciences teachers' stories tell us about their personal and professional identities and their teaching of organic chemistry?

2. What emotions do grade 12 technical sciences teachers experience when teaching organic chemistry?

3. How do grade 12 technical sciences teachers' emotions influence their teaching of organic chemistry?

Each participant will be asked the following questions:

1. What qualifications do you have?
2. What subjects did you major in?
3. How many years teaching experience do you have?
4. How many years have you taught Technical sciences in grade 12?
5. Do you enjoy teaching organic chemistry? Explain your answer.
6. Explain how the school context affects your teaching of organic chemistry?
7. Who and what factors influenced the development of your personal identity?
8. Who and what factors influenced the development of your professional identity?
9. How does your personal life experiences affect your teaching of organic chemistry?
10. Explain how your previous schooling (primary, secondary or tertiary schooling) affects your teaching of organic chemistry?
11. Describe any challenges (if any) you face when teaching organic chemistry?
12. If you have any challenges, explain how you overcome them.
13. Comment on the pace of teaching organic chemistry?
14. Describe the activities or events that contributed to your development as the teacher you have become.
15. Describe the positive emotions that you experience when teaching organic chemistry.
16. Describe the negative emotions that you experience when teaching organic chemistry.
17. How do your emotions influence the way you teach organic chemistry?

18. What factors contribute to the emotions that you have towards teaching organic chemistry?

Guidelines to design a Collage

Participants will be asked to design a collage based on their professional and personal identities and their emotions when teaching Organic chemistry in technical sciences. Samples of collages will be shown to participants, since some participants may not be familiar with designing a collage or what a collage looks like. The samples will give them an idea of what is expected of them.

Participants will be provided with the following guidelines to design their collage:

- Read through the magazines provided and cut out words, phrases and pictures that relate to your personal and professional identities and emotions when you teach organic chemistry in a technical sciences classroom.

- Explore aspects of your family, school teachers, community, childhood experiences, significant events etc. that have influenced your personal and professional identity and emotions as a technical sciences teacher. You may include as many details as possible that highlight what is unique about you.

- After finishing your collage explain in detail your personal and professional identities and the positive and negative emotions you experience as a technical sciences teacher. Explain how the significant people and events contributed to the development of your professional and personal identities as a technical sciences teacher.

- Describe the challenges and emotions (negative and positive) you experienced when teaching organic chemistry in a technical sciences classroom that has made you become the teacher and person you are.

APPENDIX 4: ETHICAL CLEARANCE

UNIVERSITY OF KWAZULU-NATAL
INYUVESI YAKWAZULU-NATALI

08 May 2023

Nomthandazo Nondumiso Fakude (211511889)
School Of Education
Edgewood Campus

Dear MNN Fakude,

Protocol reference number: HSSREC/00005535/2023
Project title: Exploring teacher identities and emotions in the teaching of organic chemistry in grade 12 technical sciences
Degree: Masters

Approval Notification – Expedited Application

This letter serves to notify you that your application received on 21 April 2023 in connection with the above, was reviewed by the Humanities and Social Sciences Research Ethics Committee (HSSREC) and the protocol has been granted **FULL APPROVAL**.

Any alteration/s to the approved research protocol i.e. Questionnaire/Interview Schedule, Informed Consent Form, Title of the Project, Location of the Study, Research Approach and Methods must be reviewed and approved through the amendment/modification prior to its implementation. In case you have further queries, please quote the above reference number. PLEASE NOTE: Research data should be securely stored in the discipline/department for a period of 5 years.

This approval is valid until 08 May 2024.
To ensure uninterrupted approval of this study beyond the approval expiry date, a progress report must be submitted to the Research Office on the appropriate form 2 - 3 months before the expiry date. A close-out report to be submitted when study is finished.

HSSREC is registered with the South African National Health Research Ethics Council (REC-040414-040).

Yours sincerely,

[redacted]

Professor Dipane Hlalele (Chair)

/dd

Humanities and Social Sciences Research Ethics Committee
Postal Address: Private Bag X54001, Durban, 4000, South Africa
Telephone: +27 (0)31 260 8350/4557/3587 **Email:** hssrec@ukzn.ac.za **Website:** http://research.ukzn.ac.za/Research-Ethics
Founding Campuses: Edgewood Howard College Medical School Pietermaritzburg Westville

APPENDIX 5: DEPARTMENT OF EDUCATION PERMISION LETTER

KWAZULU-NATAL PROVINCE
EDUCATION
REPUBLIC OF SOUTH AFRICA

OFFICE OF THE HEAD OF DEPARTMENT

Private Bag X9137, PIETERMARITZBURG, 3200
Anton Lembede Building, 247 Burger Street, Pietermaritzburg, 3201
Tel: 033 392 1063
Email: Phindile.duma@kzndoe.gov.za

Enquiries: Phindile Duma **Ref.**:2/4/8/27

Mrs NN Fakude
[redacted]
3279

Dear Mrs NN Fakude

PERMISSION TO CONDUCT RESEARCH IN THE KZN DoE INSTITUTIONS

Your application to conduct research entitled: **"EXPLORING TEACHER IDENTITIES AND EMOTIONS IN THE TEACHING OF ORGANIC CHEMISTRY IN GRADE 12 TECHNICAL SCIENCES"**, in the KwaZulu-Natal Department of Education Institutions has been approved. The conditions of the approval are as follows:

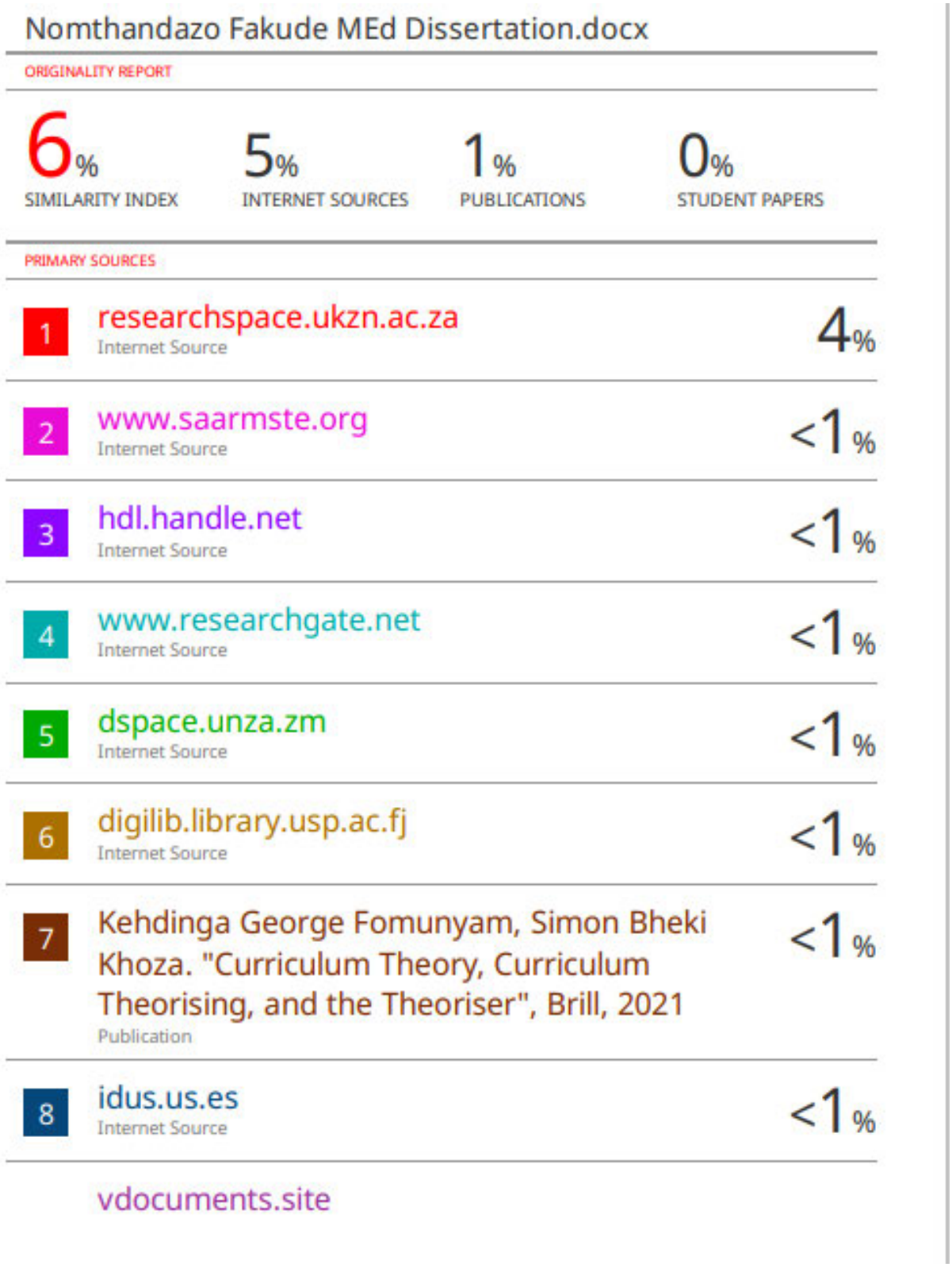
1. The researcher will make all the arrangements concerning the research and interviews.
2. The researcher must ensure that Educator and learning programmes are not interrupted.
3. Interviews are not conducted during the time of writing examinations in schools.
4. Learners, Educators, Schools and Institutions are not identifiable in any way from the results of the research.
5. A copy of this letter is submitted to District Managers, Principals and Heads of Institutions where the Intended research and interviews are to be conducted.
6. The period of investigation is limited to the period from 06 March 2023 to 31 March 2026.
7. Your research and interviews will be limited to the schools you have proposed and approved by the Head of Department. Please note that Principals, Educators, Departmental Officials and Learners are under no obligation to participate or assist you in your investigation.
8. Should you wish to extend the period of your survey at the school(s), please contact Miss Phindile Duma at the contact numbers above.
9. Upon completion of the research, a brief summary of the findings, recommendations or a full report/dissertation/thesis must be submitted to the research office of the Department. Please address it to The Office of the HOD, Private Bag X9137, Pietermaritzburg, 3200.
10. Please note that your research and interviews will be limited to schools and institutions in KwaZulu-Natal Department of Education.

UGU DISTRICT
HARRY GWALA DISTRICT

[redacted]
Mr GN Ngcobo
Head of Department: Education
Date: 06 March 2023

GROWING KWAZULU-NATAL TOGETHER

APPENDIX 6: TURNITIN REPORT



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ORIGINALITY REPORT

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APPENDIX 7: PROOF OF EDITING

LANGUAGE INSTITUTE

St Charles College,
Harwin Road,
Scottsville
Pietermaritzburg 3201
Tel: 083 593 2855
admin@kznlanguageinstitute.com
www.kznlanguageinstitute.com

Registration number: 131 804 NPO

Certificate of editing 07 July 2024

Name: Nomthandazo Fakude

Title: Exploring teacher identities and emotions in the teaching of organic chemistry in Grade 12 technical sciences

This serves to confirm that the above document was edited substantively by members of the KZN Language Institute's professional English language editing team. The document was returned to the author with tracked changes and comments intended to correct errors and to clarify meaning. It was the author's responsibility to attend to these changes.

J. Kerchhoff

Director of the KwaZulu-Natal Language Institute

KZN Language Institute – Transforming Words