Grade 3 Teachers' Understanding of the Implemented Mathematics Curriculum in Mpumalanga Province: An Action Research of Grade 3 Teachers

by

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SUPERVISOR'S STATEMENT

This dissertation has been submitted with my approval.

Date: 5 December 2023

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DEDICATION

I dedicate this thesis to:

My late mother, Mangina Johannah Madiba. Mamma, I made it!!!

My children, Makwela, Nana, Lefa, and Phenyo. Mama made it!!!

Thank you!

ABSTRACT

This pragmatic action research explores Grade 3 teachers' understanding of the implemented mathematics curriculum. Exploring teachers' understanding of the mathematics curriculum is critical given the fact that, over time, curriculum reforms take place. Such reforms impact not only on teachers' knowledge, expertise or motivation, but also on their understanding. Understanding, as synthesised by the researcher, is a planned, prescribed system of presenting one's thoughts and expertise regarding a particular subject, in this case, mathematics. In exploring this phenomenon, six Grade 3 teachers from Nkangala District in Mpumalanga were purposefully sampled to be part of this study. Data was generated through two phases of reflective activities, observations, interviews and focus group discussion. To answer the two research questions of this study, the generated data was analysed guided by the natural identity framework themes. Findings revealed that teachers' understanding of the implemented mathematics curriculum is mostly informed by a combination of their need to comply with the prescripts of policy and higher authority, and common understanding to appease the societal needs and individual understanding based on their experiences and beliefs. To embrace the three propositions of identities, the study developed the Natural Understanding Identity Framework. The framework promoted teachers' natural understanding identity which is underpinned by reflective practice, critique and adaptation to what works in their day to day practice as teachers.

LIST OF ACRONYMS

ANA	Annual National Assessment
B. Ed	Bachelor of Education (Degree)
CAPS	Curriculum Assessment Policy Statement
CK	Curriculum Knowledge
DBE	Department of Basic Education
ECD	Early Childhood Development
MEC	Member of the Executive Council
MET	Mathematical Education of Teachers
NAEYC	National Association for the Education of Young Children
NCS	National Curriculum Statement
NCTM	National Council of Teachers of Mathematics
NEEDU	National Education Evaluation Development Unit
NEIMS	National Education Infrastructure Management System
PCK	Pedagogic Content Knowledge
PIRLS	Progress in International Reading Literacy Study
RNCS	Revised National Curriculum Statement
SACMEQ	The Southern and Eastern Africa Consortium for Monitoring Educational Quality
TIMSS	Trends in International Mathematics and Science Study
ELNA	Early Learning National Assessment
VCT	video conferencing technology
ZVCT	Zoom Video Conferencing Technology
ATPs	Annual Teaching Plans
HEIs	Higher Education Institutions
GET	General Education and Training
NIF	Natural Identity Framework
NUIF	Natural Understanding Identity Framework
WHO	World Health Organisation

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CHAPTER 1

HOW IT ALL STARTED

1.1. Introduction to the Study

This first chapter of the study provides a summary of the whole research project that has a total of seven chapters, highlighting the main issues for each chapter. The chapter starts by giving the background of the study, thereafter the candidate statement, rationale, research objectives, research questions, and understanding of the evolution of the South African Curriculum. The second half focuses on a brief overview of each of the remaining chapters, reviewed literature, research methodologies, the study framework, analysis, findings and lastly, the discussions and recommendations.

1.2. Background of the Study

Underperformance in mathematics, worldwide, continues to be a thorny issue for governments of different countries. Over the years, research on mathematics has been conducted to identify what could be at the core of the problems faced. To understand what prompted this research, it is significant to first start looking at the evolution of the South African National Curriculum during the Apartheid era moving to post-Apartheid. The researcher understands that some readers are familiar with the politics of the South African curriculum; she assumes that the background is known to them.

1.3. Candidate Statement

As a teacher and researcher, I deemed it appropriate to share my personal views on education from an educator's point of view. I am a qualified foundation phase teacher with 18 years' classroom experience and 8 years serving the Department of Education as a curriculum specialist. I have been focusing on monitoring and support of curriculum implementation in the foundation phase and ensuring that school management teams also manage curriculum implementation at school level. To back up my experience are my qualifications as an educator. In 1993 I obtained a Junior Primary Teachers' Diploma at a college of education.

For the longest time I was unable to further my studies due to the responsibilities that came with starting a family, until between 2005 and 2006 when I obtained an Advanced Certificate in

Education, specialising in Inclusive Education: Physical Impairments. Reasons for this move were that this qualification was an 'in-thing'; and it was during the introduction of Inclusive Education to South Africa. The decision to acquire this qualification was based on societal influence. I adopted a common understanding that this qualification would open doors for me, as everyone believed. My expected goals of achieving the qualifications were not met except that my qualification assisted me to support learners in my class experiencing barriers to learning.

Irrespective that I was not growing professionally in the field of teaching, I was content with my job, as I was able to support my family. However, I did not know and could not explain why I was teaching. I did not have an identity in teaching until in 2008 when the then MEC for education in Limpopo called the foundation phase teachers together to attend a road show. It was then that I learnt about the SAQMEQ and TIMMS, and how poorly South Africa performs in those international tests. The MEC acknowledged the impact of Apartheid on the education of South African learners, but further indicated that underperformance cannot always be attributed to the past. Therefore, part of the problem that was identified as the main cause of underperformance was the teachers' lack of pedagogic and content knowledge. This is when I was selected as one of the teachers to be re-trained in foundation phase teaching. The MEC wanted us to have a professional identity; and to be able to understand curriculum policies, pedagogies, and content underpinning the foundation phase.

In 2012 I obtained my Bachelor of Education (B. Ed): ECD and Foundation Phase. When the bursary expired, I did not stop studying. I gathered a group of about 10 students and recruited them to enrol in a B. Ed Honours degree. This was to extend our knowledge in the foundation phase, especially on the curriculum. We then registered to study part time. In 2014 we obtained our degrees. For the purpose of this degree, I claimed my societal identity, and fulfilled societal needs, because the studying process was a joint effort with other students; and we were supporting one another. In 2015 I then tried to recruit others to further our studies to obtain a Master of Education degree. None of my acquaintances entered the master's degree course with me. I continued the lonely journey on my own, completing the study in record time and graduating in 2016. It was during this time that my personal identity was realised, as I had to navigate the whole process on my own. I used my experiences in previous studies, in my work, and what I gained when working with others to obtain the degree on my own, with the help of only my supervisor. The same year I enrolled in a Doctor of Philosophy degree (PhD) in

Curriculum Studies. The focus was still on teachers' understanding of the implemented mathematics curriculum.

Of the entire study journey, my PhD journey was the loneliest and most difficult one. As a human being who lives a natural life, I started experiencing all the challenges that life can bring. This ranged from challenges at work, promotion with added responsibilities, two of my sons diagnosed with life-threatening sickness and thus having prolonged stays in hospital, my mother's passing, losing a spouse, and many other incidents. All these disastrous events pushed me to the brink of giving up; however, I did not succumb. Nevertheless, my progress seemed very slow: I faced exclusion twice, yet I appealed successfully. It was, therefore, during this period that I had to re-reflect on my life, my career, my family, and my studies. I had to decide how best I could navigate through everything because I also did not want to give up on my dream of obtaining a PhD. I then learnt that each person is born with a unique natural identity that is neither influenced by the professionals, society, or us as individuals: we have this identity from birth (Khoza, 2021). It is against this background that I claimed my natural identity and repositioned myself by re-reflecting on and re-critiquing myself and how I live and run my life. This realisation pushed me to finish this study and to restructure my personal life and that of my family.

1.4. Rationale

Although there is evidence that foundation phase learners' performance in mathematics is improving, South African learners in other phases of the system, i.e., intermediate, senior, and further education and training phases, continue consistently to underperform in mathematics. This continued underperformance is posing some serious threats to the efforts put in improving the mathematics performance in the country. More than a decade later, we still have challenges of mathematics underperformance in various assessments that learners are exposed to, which include international, national, provincial, district and school-based assessments, provincial assessments (Department of Basic Education [DBE], 2010). For This reason, the DBE acknowledges that "The results of both national and international studies reveal quite clearly that South African schools are failing our children in helping them develop the necessary skills and mastery to do mathematics" (DBE , 2012, p. 1). This suggests that this is a recurrent challenge that needed to be researched.

A number of factors have prompted me to conduct a study on teachers' understanding of the implemented mathematics curriculum. Firstly, I am currently a foundation phase deputy chief education specialist. One of my responsibilities is to ensure curriculum management and delivery in the foundation phase of schooling. Monitoring and support for school management teams, especially the deputy principals and departmental heads of curriculum management, are my core functions. I also provide monitoring and support in all the four subjects offered in the foundation phase, i.e., home languages, mathematics, first additional language, and life skills. Secondly, there have been many programmes over the years that have been designed to improve the teaching of mathematics in Grade 3 as an exit grade for foundation phase; therefore the study also seeks to evaluate whether the programmes have yielded positive results in terms of teachers' understanding of the implemented mathematics curriculum. Again, the findings of my 2016 study on subject advisor's reflections on the support for the implemented mathematics curriculum has revealed that teachers lack understanding of mathematics content and how to teach it. Teachers therefore need more support in delivering the content (Galane, 2016). For this study, I explored Grade 3 teachers' understanding of mathematics for two reasons: firstly, because Grade 3 is an exit grade in the foundation phase. Also, most of the time, the success of learners in the intermediate phase during the international assessments reflects what learners have learnt in the foundation phase. Secondly, there is a growing concern shown by teachers and in the literature that, when learners transit from foundation (Grade 3) to intermediate phase, especially in Grade 4, their performance deteriorates. I therefore believe that there is a need to conduct a study of this nature in order to explore teachers' understanding of the mathematics curriculum and assessment policy statement (CAPS) which they implement.

he results of this study may not only assist me in my journey as a curriculum specialist, but may also add value to the body of knowledge related to mathematics curriculum implementation. Furthermore, it may help stakeholders in education, including higher-education institutions to fine-tune their teacher-education programmes in alignment with the Department of Education's provision for improving teachers' understanding of the implemented mathematics curriculum.

1.5. Objectives of the Research

1.5.1. To explore Grade 3 teachers' understanding of the implemented mathematics curriculum

1.5.2. To explore why Grade 3 teachers have a particular understanding of the implemented mathematics curriculum.

1.6. Research Questions

1.6.1. What are the Grade 3 teachers' understandings of the implemented mathematics curriculum?

1.6.2. Why do Grade 3 teachers have a particular understanding of the implemented Grade 3 mathematics curriculum?

1.7. Understanding the Curriculum: Evolution of the South African Curriculum

The word curriculum originates from the Latin 'currere', which means to run, as in a course (Hoadley & Jansen, 2013). This has been interpreted by Van den Akker *et. al.* (2009) as a course for learning in an educational setting. Kelly (2009) compares the learners with athletes. Van den Akker *et al.* (2009) interpret this as a race to be run by learners wanting to reach a finishing line. The researchers contend that this race has obstacle courses or hurdles (subjects) along the way that must be overcome. This therefore suggests that, in this race (the curriculum), teachers serve as coaches. Teachers must therefore ensure that their athletes (learners) are fit and ready to run and able to reach the finishing line. Hence Glatthorn *et. al.* (2012) emphasise that, in defining a curriculum, two criteria must be met.

Firstly, curriculum should reflect the general understanding of the term used by teachers; thereafter it should be useful to educators in making operational distinctions (Glatthorn *et al.*, 2012). This implies that teachers, as implementers at school level, should be able to interpret and understand the curriculum in a way that enables them to position themselves and their roles as implementers in the curriculum development process to enable learners to achieve the best end results. Other curriculum stakeholders: national decision-makers/developers, publishers, provincial and district education departments, non-governmental organisations, academics, institutions of higher learning, parents, and any other entity or person involved in curriculum matters, should be able to interpret and understand the curriculum through their respective lenses. Still using the analogy of a race, positioning teachers as coaches for it to be successful, there are various stakeholders involved, e.g., the team manager, the technical team, the sponsors who provide team attire and finances, referees, supporters, and more. Each of these people has a different view, role, and responsibility to the team and the race itself. Similarly, in the curriculum, the choice of interpretation and usage of words is a reflection of the user's perspective (Hewitt, 2006).

In an educational setting, scholars have offered countless definitions and supplied their conceptualisation of a curriculum. Kelly (2009) argues that a curriculum should be defined taking into consideration the four dimensions which he identifies as the intentions of the planner. These dimensions are the procedures adopted by curriculum planners, the actual experiences of learners resulting from the teacher's efforts to carry out their or the planner's intentions, and the hidden learning that happens as a by-product of how the curriculum is organised. Kelly's (2009) position is observably informed by what is well known as the Tyler rationale. According to Tyler (1949), the provision of curriculum by any developer of curriculum should be based on four significant questions which he regards as the foundations of curriculum development. Firstly, what educational purpose should the school seek to achieve? Secondly, what educational experiences can be provided that are likely to be successful in achieving this purpose? Thirdly, how to effectively organise these? Lastly, how to evaluate whether these purposes are being attained?

This definition should enable teachers to start understanding the curriculum in the way the designer intended; also understanding reasons for the inclusions. Secondly, procedures to be followed must be understood, together with the way these should be followed when implementing the curriculum. Next one must ensure that teaching yields positive results for learners; such is mostly revealed through assessment. Lastly, teachers must also understand why certain practices are excluded from the curriculum, yet deliberately practised in schools, e.g., the teaching of life skills towards the end of the school day. Kelly (2009, p. 13) therefore defines the curriculum as "the totality of the experiences the pupil has as a result of the provision made."

According to researchers, curriculum has three main role players, which are the planners, the teachers and learners. It starts as a vision by curriculum planners or developers, they then develop it for implementation and for implementation to take place the teacher should understand what will be taught (content) and how it will be taught (pedagogy) to learners as per the set principles (Stenhouse, 1975; Bernstein, 1999; Van den Akker *et. al.*, 2009; Pinar, 2004
There is, therefore, consensus in literature that a curriculum is a planned and guided framework of what is to be taught and learned in a formal educational setting so that learners can achieve specific goals by the end of their schooling years, as outlined (Booyse & Du Plessis, 2014; Hoadley & Jansen, 2013; Deng, 2010; Van den Akker *et. al*, 2009; Kelly, 2009; Pinar 2004, Kelly, 2009 and Schiro, 2008). Concurring with the above definition, Deng (2010); Stabback, (2016); Garcia-Huidobro (2017); Soini, *et. al.* (2017) and Jansen (1998) add that curriculum is a

political agenda and a social agreement that serves as a mediator of the culture and values of the society; while taking into account local, national, and global needs and expectations.

So many broad definitions of curriculum affirm the notion that curriculum is a complex and controversial phenomenon in that its decision-making process has technical, practical, and political implications, with various types of curricula (Pinar, 1995 & Johnson-Mardones, 2015). These broad definitions and conceptualisations of curriculum therefore explicate a link between what is to be taught, the teachers, and the learners. This implies that one cannot happen without the other. What is to be taught in school is informed by the intentions of policy makers at national level for teachers to implement at school level; and for learners to learn and be assessed on, thus evaluating whether the curriculum has achieved its goals.

Khoza (2018); Berkvens, *et.al.* (2014); Hoadley and Jansen (2013) and Van den Akker *et al.* (2009) concur that there are three levels of curriculum distinction or representations in a teaching and learning situation. These levels are the intended, the implemented/enacted, and the attained/assessed curricula. The definition of curriculum may be narrowed; however, one should contextualise the definition according to the needs of the study or the purpose for which the curriculum will then be used. Is the focus of the study on the intention (intended), on the action (implemented/enacted), or on the product (attained)? For the purpose of this study, the focus is on the implemented curriculum; however, the discussion starts with the intended curriculum, it being the foundation of the implemented curriculum. For implementation to happen, a plan (intention) should be available. The attained curriculum, which is not in the scope of the study, is also briefly described; this curriculum informs whether the curriculum has met its aims and objectives; if not, curriculum reform is indicated.

Deng (2010) also made mention of the three levels of curriculum − the institutional, programmatic, and the classroom curricula. Deng (2010)'s levels, however, do not cater for the attained/assessed curriculum, but only for the intended (institutional and programmatic) and the implemented (classroom) curricula. On the other hand, the three levels identified by Khoza (2018); Berkvens *et al.* (2014); Hoadley and Jansen (2013); and Van den Akker *et al*. (2009) are rather imprecise about the institutional curriculum, which, according to their discussions of curricula, is incorporated into the intended curriculum. For certain reasons, Deng (2010) has separated the institutional from the programmatic curriculum.

From Deng's definitions, the intended curriculum does not denote the institutional curriculum; instead, its definition matches that of the programmatic curriculum. Therefore, in the South African context, both the institutional and programmatic curricula as identified by Deng (2010) form the intended curriculum. The current national curriculum statement Grade R-12 is not separated from the curriculum and assessment policy statement for each subject. Both are embodied in one policy document. This is contrary to the curriculum 2005 and the revised national curriculum statement's outcomes-based curriculum. The institutional curriculum document was provided separately, as were the overview of the curriculum and the learning area statements and guidelines for assessment.

1.7.1. The Intended Curriculum

As alluded earlier, the intended curriculum is a plan of what will be taught (Stenhouse, 1975; Pinar, 2005; Van den Akker *et al.*, 2009, p. 9) and how it will be taught by teachers to learners (Pinar, 2005; Khoza, 2018). Deng (2010) labels the intended curriculum the programmatic curriculum, excluding the institutional curriculum. A concern with these definitions is that one may contradict the institutional curriculum. I view the institutional curriculum as a component of the intended curriculum in the South African context, but serving a different purpose according to its characteristics. The institutional curriculum, according to Deng (2010) is the conception or framework, at national and political level, of what an ideal schooling system should be like, intertwining schooling, society, and culture, even beyond schooling. At this level of curriculum, broad curriculum goals are stated with the aim of schooling being to create critical and creative thinking in learners. The institutional curriculum does not list or provide details of the subjects that will be taught, or skills that will be developed in learners by each subject. However, the institutional curriculum provides a broad overview of what the national curriculum aims to achieve and the type of learner that will be produced at the end of the schooling system. Currently, the South African National Curriculum Grades R-12, incorporated in the foreword of CAPS for each subject serves the purpose of an institutional curriculum. The CAPS for each subject is then interpreted as the intended curriculum.

The intended curriculum concerns intentions of policy makers and curriculum developers at the development/ design level nationally, which are in curriculum policy documents. Curriculum at this level includes the national policies detailing subjects to be taught, content that learners are to learn, reflecting visions or rationale, aims, teaching methods, time allocation and assessment;

both formal and informal assessments (Booyse & Du Plessis, 2014 and Khoza, 2014, Deng, 2010). Decision-making as to what should be included as worthy of learning involves collaboration of stakeholders in education. Such includes politicians, government officials, curriculum developers and specialists, representatives from teacher unions, non-governmental organisations, traditional leaders, university-based intellectuals and other stakeholders whose interest is in education matters (Khoza, 2014; Deng, 2010; Chisholm, 2005; Crosswhite, *et. al.*, 1986). The intended curriculum, after being approved, is then disseminated to teachers for implementation, translated then as the implemented curriculum.

In the South African context, the intended level of curriculum may be related to the South African national curriculum which has been under reform post-Apartheid, i.e., from 1994. In this study, it is deemed necessary to open the discussion with the pre-1994 curriculum. This starts with the Apartheid education model with special focus on Bantu education and people's education. Thobejane (2013), in a paper that outlines the rationale of Bantu education available to South African Blacks from 1953 to 1992 argues that a proper understanding of the pervasive impact of Bantu education on the majority for a period of almost 60 years is crucial. The rationale for this discussion is based on the assumption that all participants in this study are Black South Africans. Some participants may have experienced the Apartheid education then as teachers or as students, which may inform their current understanding of the curriculum as they reflect on their previous experiences (individual understanding). Therefore, the history of education pre-1994 during the Apartheid government education, with the main focus on Bantu Education curriculum cannot be overlooked.

1.7.2. The pre-1994 South African Apartheid curriculum

Although it may seem that research is over-emphasising the issues of curriculum development in South Africa since the Apartheid era, one cannot ignore that these deliberations may serve as a foundation in informing teachers' views and understanding of current curriculum policy development and practices. Glatthorn *et al.* (2012) confirm that it is beneficial for both scholars and practitioners to understand the history of curriculum development because they gain a deeper awareness of the extent to which curricular changes are often influenced by and are a manifestation of larger social and political forces. Again, the history of curriculum offers curriculum users a broader perspective from which to view curriculum reform; these innovations more often than not seem to reflect and reverberate the past. Furthermore, due to the state of

South Africa pre-1994, the developments that have taken place to date, the state of the curriculum implementation and performance of learners; it seems warranted to reflect from where the South African curriculum emerges historically. This reflection may serve as a thought-provoking exercise to stimulate the assumption of the past understanding of teachers compared with their understanding of the current mathematics curriculum.

South Africa, like other countries that were colonised by the Europeans, has its fair share of challenges regarding its education system. The country is notorious for its Apartheid government and its marginalisation practices by Whites to all non-Whites, i.e., Blacks, Indians, and Coloureds. According to Nkondo (1979), the National Party became a ruling party in 1948 and before then, South African education for all racial groups was identical until the This implies that educational policies that were in place, the intended curriculum and the evaluation of same were not differentiated as during the Apartheid era. The National Party started to review policies. The new government deemed the system of education unsuitable, introducing the Apartheid Education. The impression of policy review or curriculum reform is mostly to improve the quality of education; however, this was not the case in South Africa.

This change led to each racial group having its own system of education (Nkondo,1979) − this racial division led the country to have nine examining bodies, informed by Eurocentric philosophies, which glorified European values and traditions. The indigenous culture and beliefs of other racial groups were suppressed (Jansen, 1998; Harley *et. al.*, 2000). Until the National Party took over in 1948, education for both Blacks (regarded as the most inferior), and Whites was regulated by the Policy of Christian National Education (CNE). The Congress of the National Party took a resolution that the national education policy should conform to the Federasie van Afrikaanse Kultuurvereniginge (FAK)'s version of CNE (Eshak, 1987). In other words, the CNE had a version of educational policy that was aligned with the FAK version.

The impression portrayed by the FAK version of the policy in black and white was that the policy was applicable to and to be implemented by all racial groups in the country. However, the policy was not explicitly applied to White education "only certain aspects of the policy, it has been argued, can be recognised in the Bantu Education Act and the educational legislation of the 1960s (Eshak, 1987). Instead, White learners were privileged because their curriculum was more content-centred and academically inclined and controlled by the state. Conversely, the Blacks

received the more inferior, watered-down, and culturally inclined Bantu Education controlled by churches.

The government of the day was not pleased with how the CNE was educating the Bantu (Blacks). They believed that the CNE was preparing blacks to think themselves Europeans despite not being so. The government then instigated a commission of enquiry, the Commission on Native Education, which was later famously known as the Eiselen Commission, headed by Dr. W. W. M Eiselen between 1949 and 1951, to investigate the state of education for natives of the country.

The task of the commission, according to Molete (1995); Eshak (1987); Huddleston (undated); Kumalo and Skosana (2014) and Hofmeyer (2015) was to formulate aims for the Black (native) people's curriculum, modifying the training of Black teachers in alignment with the aims of the curriculum; also to design curriculum content in such a way that it would effectively prepare Blacks for their future occupations. Furthermore, the commission was to recommend how the education system should be organised, administered, and resourced, financially. Based on the above responsibilities of the commission, it is clear that government did not want in any way at all to allow Blacks and Whites to have integrated utilisation of resources, or to have any kind of relationship whatsoever. Ironically, the commission was actually tasked to set up and tighten boundaries in education.

Education then was mainly used to divide races and to prepare different groups for dominant and subordinate positions in social, political, and economic life (Pillay *et. al.*, 2013). This is evident based on the statement made by J. N. le Roux, the then National Party politician who commented that Natives should not be exposed to any academic education because if it happened that they are exposed to education that advances them academically, there will be no one to do manual labour for the Whites. This remark is linked to one of Verwoerd's 5 December 1950 speeches. Verwoerd articulated clearly that Black people should only be educated to serve their communities, not belonging in European communities. Therefore, the Eiselen commission recommended mass education for Blacks; to this effect, government should commit itself to building more schools, especially at primary school level (Molete, 1995). This position favours teaching and learning from common understanding influenced by opinions of society, general knowledge and oral conversations (Bernstein, 1999; Khoza, 2015a, 2016b).

The commission further recommended the development of a functional literature in African languages to be used as a medium of instruction in the first eight years of schooling. The two official languages would have to be introduced as subjects at higher primary school level. This means that the commission was advocating for mother-tongue instruction in Black schools (Molete, 1995). Clearly the move to exclusive mother-tongue instruction was not meant to capacitate learners cognitively, as instanced by the advocates of mother-tongue instruction such as Daniel (2003). This researcher postulates that, in the early years, teaching learners in their mother-tongue lays a foundation that enables them to easily acquire their second language later in their schooling (Daniel, 2003). The recommendations were biased to the needs of the Apartheid regime, not to the interests of the Black South African majority.

Parsons (1982) highlighted that after the introduction of the Bantu Education Act of 1953, the syllabus of Black schools and non-Black schools were separated, with , Blacks following the Bantu Education syllabuses based on officially recognized Bantu languages. Primary schools were instructed to stop using English as a medium of instruction and it was then introduced in secondary only. Parsons (1982) further adds that the Bantu Affairs Department had to approve teachers, their employment, and their role, amongst other matters (Bantu Education Act 47, 1953). This suggests that a teacher did not have a voice in Bantu Education policy implementation, therefore, whether they understood or not was not government's concern. What mattered was that they were under control and conforming, which may be reminiscent of slavery.

In the booklet, *A History of the South African Democratic Teachers' Union [SADTU*] (Kumalo & Skosana, 2014), the authors purposefully focused on the adverse effects of Apartheid education from the 1950s to 1994, and the set of forces that shaped teachers' politics and gave birth to the union. In the booklet, the consequences of Apartheid are noted as negative for the African teaching force, as such led to unequal funding for Black education, resulting in inferior teacher training programmes, low salaries, poor conditions of service, and under-resourced schools (Kumalo & Skosana, 2014, p. 11). Similarly, studies of the Apartheid regime conducted earlier highlight that provisioning of human and financial resources for White and Black children were worlds apart. Learner-teacher ratio for Whites was 18: 1, whereas for Blacks it was 40:1. Some 96% of White teachers were certificated compared with only 15% of the Black majority of teachers. Besides mediocre financial provisioning, which was one-tenth of what was provided to Whites, Black schools were disturbingly under-resourced, with overcrowded classrooms (Molete, 1995; Morrow, 1990; Donald & Soudien, 1999 & McKeever, 2017).

Furthermore, education policy decision-making and policy approach was top-down, highly centralized, with stringent measures used to control what should and should not be taught in South African schools (Harley *et. al.*, 2000; Ramparsad, 2001; Cross, *et.al.*, 2002 & Hoadley and Jansen, 2013). This stance was problematic because, according to Harley *et al.* (2000), curriculum delivery and implementation is dependent on strong links between national and provincial departments and schools; and between these institutions there must be clearly defined levels of responsibility and autonomy. Therefore, this suggests that successful curriculum development is relies on the collaboration between the various stakeholders in the process, which will include curriculum designers from government, teachers, parent groups, union representatives, and non-governmental organisations, inter alia.

Opponents of the top-down only approach to curriculum add that curriculum reform and decision-making should neither use a bottom-up nor top-down approach, but be more inclusive. Both approaches and their processes should be combined to create political consensus, ensure equity, and develop local capacity for frontline implementers. Furthermore, when the top management for curriculum development adopts both approaches to curriculum reform, this would result in sustainable changes, because the strengths of both the bottom-up and top-down approaches complement each other (Darling-Hammond, 1997; Fullan, 1999; Valli & Buese, 2007; Hargreaves & Fullan, 2012; Kim *et. al.*, 2014; Ramberg, 2014; Petko *et. al.*, 2015). This said, merging both the common and every-day approaches to curriculum may offer teachers a strengthened understanding with improved curriculum implementation and learner attainment. This position was, however, not practised during the Apartheid regime: Blacks were considered inferior and of little value compared with their White counterparts.

According to Hoadley and Jansen (2012) the Apartheid curriculum was specific to a subject, highly content-based, more theoretical and abstract, which led to learners learning without relating to what they were learning. Authoritarian teaching and rote learning for Black learners were the order of the day, and based largely on question-and-answer methods, and individual writing by learners. The curriculum focused on mastery of skills, disregarding learners' understanding; which posed learners as passive participants in their education (Hoadley & Jansen, 2012). Such was aligned with the behaviourist perspective of teaching and learning. I can relate with the above saying because I still have vivid memories of being made to recite poems such as 'Lui Letta' (Lazy Letta), or 'Die spinnekop en die vlieg' (the spider and the fly)

without even understanding what Lui Letta meant. To date, I cannot tell why we were made to recite those poems because one cannot confidently say that they were used to develop our Afrikaans language skills. We did not understand what the words meant; similarly, teachers may not then have been able to explain the skills they were developing in those lessons, and why they were teaching us that content.

The curriculum did not promote critical thinking for learners (Cross *et al.,* 2000); and teachers did not have the autonomy to decide what to teach, because the curriculum did not allow for flexibility and creativity in teachers. Kelly (2009) views curriculum as a social phenomenon that unites people of all racial groups and at the same time empowering people to use their freedom and independence of thought; embracing their differences by respecting each other's opinions and views. In spite of concerns of scholars and philosophers, the curriculum model used was contrary to the view that the teacher must be conversant with ideology, bias, political agendas and hegemonies that influence what is taught, how, and by whom. Therefore, the Bantu Education curriculum model was limiting the teacher's understanding of the political and social purpose of education in society, including and understanding of content, pedagogy and the role of assessment in children's learning. This suggests that if teachers were given more autonomy on curriculum development, they would have more than a general understanding of the curriculum; but also the development of cognitive, emotional, and expression of content learning (Ramparsad, 2001); however, this was not the case during Apartheid.

Teachers during the Apartheid era were viewed as technicians and as implementers of the curriculum. Teachers were to ensure conformity and education authorities ensured this by conducting school inspection to monitor teachers' compliance (Hoadley & Jansen, 2013). Viewing teachers as technicians is actually positioning them as experts who have expertise and are well qualified in their discipline, because technicians are specialists in their field. However, that was not the case for Black South African teachers. These teachers were mostly underqualified or unqualified as teachers, therefore employing common understanding informed by societal needs. The curriculum of Blacks was culturally inclined: it promoted each ethnic group as an independent entity from other groups in society.

Despite teachers being under-qualified or not qualified, a curriculum was imposed on them to be implemented at school level. This was achieved through tight supervision by a Black inspector allocated to a particular area. The allocated inspector was also closely monitored and under the

supervision of a White inspector and was reporting to him (Jansen, 2004). The inspector's core duties, according to Jansen (2004), were to ensure that teachers conformed and taught according to the dictates of the master, following the specifications of the syllabus without deviation. This implies that a top-down approach to curriculum was imposed on teachers. Such concomitantly disempowered them, leaving them voiceless in curriculum development and decision-making processes. Education in schools used a more teacher-centred approach; teachers were provided with syllabuses that were to be translated to manageable schemes of work. The content was to be taught to the learners regardless of its relevance to the targeted audience − the learners. Teachers were only allowed to use prescribed texts and were not allowed to deviate as deviation was considered a misconduct and undermining of authorities. This suggests that teacher autonomy was compromised because they were made to believe that textbooks content developers are the only ones who have subject matter expertise and possess valid knowledge that should be disseminated to all learners (Stoffels, 2008).

According to Apple (1992), most teachers were content with those curriculum prescripts and accepted using them as essential tools because they [teacher], could not offer their own tools to utilise; even were they were able, they were not allowed to. On the other hand, even if teachers needed to be resourceful and to showcase their expertise, they would not have been able to do so, due to lack of relevant pedagogy related to their teaching. Being unqualified or underqualified as teachers was also disempowering: this was the aim of the Bantu Education. Teachers' dependence on forcefully implemented curriculum and limited resources marginalised them. This may be argued as true because in schools, due to limited roles of teachers as curriculum developers, teachers still use prescribed texts supplied by publishers, non-governmental organisations and the Department of Basic Education in the hope that such will assist them in improving their classroom practice. Apple (1992, p. 10) cautions that "texts are part of a complex story of cultural politics; they can signify authority or freedom." Therefore, the roles teachers, as pragmatists, are to critically reflect on their practices, whether they are authoritative or democratic; such will only happen when teachers understand the curriculum and the schooling system. When the teachers critically reflect, this leads them to being consciously aware of the injustices and the politics of curriculum, therefore rightfully resisting some of the practices of teachers in the 1980s.

In the 1980s the People's Education (PE) was introduced as people were no longer abiding by the Apartheid education system laws. Blacks took a decision to defy Apartheid education and it principles, therefore, for them, people's Education was an answer to their oppression woes. Galane (2016) observed that, the main pillars of the People's Education were Freire's ideas of emancipating the oppressed by offering them a learner- centred curriculum that was aimed at social reconstruction. Furthermore, learners were to be taught integrated content that could be related to their day to day experiences, including the realities of the struggle that their people were going through. Their move was typical of what Hoadley & Jansen (2012) call a critical theory curriculum model, which put to the forefront the critical pedagogy practices as it was encouraging teachers, as agents of knowledge to be enlightened. In this case, the role of teachers in education policy decision-making, including implementation, may not be underrated: teachers are the foot soldiers in curriculum innovations.

Critical pedagogy, according to Andrews (2014), is associated with maximising the relationship between teaching and learning. Critical pedagogy is described as a continuous process of unlearning, learning, relearning, reflection and evaluation. This suggests that critical theory demands teachers' individual understanding, and is also reflective in nature. Freire argues that the positive impact of these actions on students who have historically been and continue to be disenfranchised by traditional schooling can become successful. Jansen (1998) noted with concern that curriculum is now what people think it is. It has a political motive and learners are always teacher what authorities have selected as formal knowledge and also teaches more than what is to be taught

Critical then became relevant for South Africans as the oppressive Apartheid system needed to be interrogated and teachers were the ones who were better positioned to take up this responsibility (Galane, 2016). Accordingly, teachers were given a platform on which to raise their concerns and questions on how other and particular knowledge or practices were taken into policies to be actively implemented by them, yet without their involvement. Initiatives taken to support the CNE never became part of the official curriculum; as a result, the movement weakened and lost momentum (Hoadley & Jansen, 2012). It is against this background that Kumalo and Skosana (2014, p. 10), in SADTU's booklet on the history of the organisation, proclaim that during this period "young militant teachers protested against the inequalities in education until 1994 when SADTU began to make its presence felt in the educational and political arenas of the new, democratic South Africa for which the union and its members fought

for." Teachers were thus beginning to be enlightened and were resisting the oppressive nature of the Apartheid curriculum, not only as it impacted on them, but also on the type of education offered to them. During those times, mathematics, as even today, was one of the compulsory subjects from primary level in Sub-Standard A (Grade 1) to Standard 7 (Grade 9); mathematics was a choice in senior secondary level from Standard 8 (Grade 10) to Standard 10 (Grade 12).

1.7.3. The pre-1994 mathematics curriculum

The Department of Education, in its definition of mathematics, points out that mathematics has its own specialised language, which positions it as a language that makes use of symbols and notations for describing numerical, geometric and graphical relationships. Mathematics is a purposeful human activity that involves observing, representing, and investigating patterns and qualitative relationships in physical and social phenomena, and between mathematical objects themselves. Mathematics also helps to develop mental processes that enhance logical and critical thinking, accuracy, and problem-solving that will contribute to decision-making (Department of Education [DoE], 2002 & DBE, 2011a, p. 8). In other words, this definition highlights that, although mathematics does not only cater to the experts by using its own specialised language and special symbols, it also demands a common understanding, being associated with social phenomenon and relationships. Furthermore, engaging in mathematics develops personal understanding as people engage in logical and critical thinking.

Dr Verwoerd was vocal where it concerned the education of Black South Africans during his time as a Minister of Native Affairs. Despite the position and assumptions that mathematics is one of the most valuable subjects in societies worldwide, Verwoerd deemed it necessary to deprive Black children of mathematics education. During the Apartheid era, Dr Verwoerd regarded the teaching of mathematics unimportant for Black learners. He vehemently condemned it, arguing that teaching Black children mathematics was a waste of time because their position in society was restricted to certain forms of labour − there was no way that they would be using mathematics to advance their lives (Ma, 1987). Mathematics, according to Dr Verwoerd, was only important for White learners because they, not Blacks, were to occupy top positions.

Furthermore, Blacks' cognitive ability was regarded as low or poor compared with Whites; therefore they would not understand mathematics. The mathematics syllabus for primary schools

up to Standard 2 was taught in mother tongue, and generally by unqualified or underqualified teachers. This position resonates with the findings of Seroto (1999) that although arithmetic was one of the subjects regarded as important in missionary schools, it did not, however, form part of the curriculum in the 1944 two-year Native Higher Primary Certificate until later in 1946. The reason for not offering arithmetic at teacher training was that Black people were often not associated with scientific subjects. This resulted in arithmetic being taught by unqualified teachers or those qualified in teaching but who had not specialised in the subject. Teachers were not trained in a way that would advance their mathematical understanding based on facts and grounding it on theories of mathematics, mathematics teaching, and how children learn mathematics. The teachers' understanding was limited to everyday and individual understanding. Despite their teaching practice being teacher-centred and content-based, it was easy for them, due to lack of mathematics expertise, to depend on everyday knowledge of teaching mathematics content.

There is limited research on the content taught to learners except as mentioned by Nkondo (1979) that the syllabus of arithmetic for both Standards 1 and 2 (Grades 3 and 4) were identical. Nkondo (1979)'s research compared the syllabus of the Bantu education department with that of the Transvaal education department on related matters. Besides the issues around the syllabus, Nkondo also outlined the differences in time allocation for each subject for both Bantu education (Blacks) and Transvaal education (Whites), school-going age for learners of both racial groups, teachers' guides, and content of other subjects like geography and history. Content that was taught at teacher training schools for teaching at primary level has been identified by Seroto (1999). This content included notation and numeration, simple and compound rules, addition, subtraction, multiplication, division and reduction of the more common weights and measures. This content was taught in the first year of study. During the second year, the content of first year was extended by including fractions, simple proportion, practice, and making out of tradesman's bills (Seroto, 1999). The mathematics curriculum was therefore not promoting critical thinking and problem-solving. Teachers' content knowledge, pedagogic content knowledge and curriculum knowledge which are identified as key pillars to successful mathematics understanding by Shulman (1986) were not promoted; there is no mention of any teacher development workshops or in-service training. Therefore, the inferior mathematics education that was offered to teachers then may account for their understanding of mathematics now. The majority of teachers who attended the former Apartheid colleges of education are still

in the system. Such teachers are mostly found in the foundation phase where this study is taking place; some of the participants may have experienced this type of training.

Black children were to be socialised through education to accept subordination and inferiority as something natural (Seroto, 1999). This position was achieved through provisioning of inferior education to Blacks, teaching them subjects that were preparing them to do manual work and being taught using mother-tongue from Sub-Standard A (Grade 1) to Standard 2 (Grade 4). The aim of this provision was to prevent Blacks from reaching their full potential; education was used for that paralysis. All these formed part of endless tensions in the spheres and horizons of South Africa which prompted society's, teachers' and the youth's resistance of the Bantu Education and other Apartheid policies. The continuous unrest and boycotts of the Apartheid system lasted until the first democratic elections in 1994, which saw the ANC government in power from then on.

As a democratically elected party, transforming the Apartheid education system was key; the education was "fragmented, racially polarised and profoundly unequal" (Harley *et al.*, 2000, p. 287). Therefore, there was a need to transform the education system in order to provide equity in terms of educational provision and to promote a more balanced view of the South African society (Botha, 2002). This included redefining curriculum, change of regulation in relation to access to schools, how schools should be governed, by introducing democratically elected school governing bodies, and employment of teachers amongst other things. To dismantle the Apartheid system, the ruling party, the African National Congress, put in place comprehensive and ambitious education policies post-1994 (Chisholm, 2003). This transformation led to the introduction of the Curriculum 2005 that was to be implemented in all South African schools for all South African learners, irrespective of race and colour. Chisholm (2003) argues that C2005 was a pedagogic route out of Apartheid education with a framework that was non-prescriptive, open, and promoting teachers' autonomy in terms of selecting content and resources to support teaching and learning.

The introduction of this curriculum model therefore demanded teachers that would have common/everyday understanding. Teachers would have to adhere to its practices in terms of overall goals of the curriculum enactment as their key responsibility, which would inform other components of curriculum, such as content, assessment, learner activities, time allocation, resources, environment, and more.

1.7.4. Curriculum 2005 (C2005), Revised National Curriculum Statement Grades R-9 (RNCS)

In 1997, the first post-Apartheid curriculum, Curriculum 2005 (C2005), was introduced to be implemented in 2008. Curriculum 2005 was modelled on outcomes-based education (OBE). Within a short period of time cracks were starting to show during implementation. The curriculum became clouded with controversy for some of the following reasons that were researched in the process. Firstly, Carl (2009) and Cross *et al.* (2002) observed that Curriculum 2005 was the type of curriculum that represented an example of a bureaucratic-driven process of curriculum which had a gap of hindering the creative curriculum and promote centralised, decision making. Such meant that the controversies were going to affect how teachers understand the whole curriculum, given their background and context.

Secondly, outcomes-based education was an internationally borrowed form of standards-based national curriculum linked to formative and continuous rather than summative assessment. Such was news to teachers used to summative assessments that were not even standardised. The competing and often contradictory policy demands made generated high levels of confusion and concern among teachers; more often than not, teachers had to read and understand what underpinned the curriculum, what they needed to teach, and how to teach it. Teachers could not have gone about teaching without engaging with the materials provided to support curriculum enactment. OBE placed more emphasis on documentation because, with any new innovation there must to be a point of reference. That, to opponents of OBE, seemed to be problematic. It should be noted that teachers had to change from their habits (individual) of teaching the same thing that stuck in their minds for decades, because with the Apartheid education, the syllabus never changed. Teachers were teaching the same content for many years; there was not even a need to refer to the syllabus or the scheme of work book any more. The Apartheid education turned them into ‘specialists’ of the subjects they were teaching.

Furthermore, training was too short and conducted by facilitators who were, themselves, not professionally trained. The curriculum was overloaded with terminology that was too difficult for teachers to decode. Furthermore, the curriculum’s outcomes-based model had many learning areas, with 66 specific outcomes, phase organisers, range statements, and so on. After consultation with various stakeholders, it was pointed out that one of the factors that influenced the failure of the outcomes-based curriculum was that the language was too complex and inaccessible to teachers. Lastly, OBE also had too much administration; there was a great deal

of paperwork to be done. This was problematic because it made teachers lose focus on teaching and become more concerned with record-keeping (Jansen, 1998 & Chisholm, 2007). Teachers were therefore expected to fulfil societal expectations of the new government which demanded their common understanding of the curriculum. Teachers, in an attempt to meet the needs of the new government and lack of proper orientation into the new curriculum, continued with their habits of teaching, which Khoza (2016a) dubs habitual actions. Khoza argues that teachers' habitual actions (individual/personal) help them to understand themselves and their social responsibilities. Habitual actions are therefore foundational in helping teachers to choose whether to implement the curriculum from the common/societal or the expert/professional understanding. Despite government's attempts to support teachers and their continued frustrations during implementation, challenges continued. These challenges appeared also in the enactment of mathematics due to the nature of its framework underpinned by outcomes.

1.7.5. The C2005 (OBE) and the RNCS mathematics curriculum

The buzz word when talking about this new education system innovation was OBE, which stood for outcomes-based education. In outcomes-based education, the mathematics learning area included interrelated knowledge and skills (DoE, 2002). The C2005 OBE Mathematics Grades R-9 was represented in a 110 page curriculum document with Chapter 1 focusing on the introduction of the national curriculum statement. The second chapter focused on the foundation phase mathematics learning area. The third and fourth chapters dealt with intermediate and senior phases respectively; and the last chapter was on assessment. The mathematics learning area had five learning outcomes, i.e., numbers, operations, and relationships; patterns, functions, and algebra; space, and shapes (geometry); measurement, and data handling. Assessment standards were presented for each learning outcome, representing what the learner should be able to do at the end of each Grade. As this curriculum is underpinned by the process/competence approach to curriculum, its main concern is to develop the child as a human being (Kelly, 2009). This justifies C2005's unclear pacing of content and time allocated for each concept to be taught. Furthermore, according to Kelly, the competence curriculum takes into account and embraces all the dimensions of education and curriculum which are the curriculum purpose, principles, values, and content. According to Bulut (2007), a proponent of the competence curriculum, the purpose of this model of curriculum is to change the focus and content of the curriculum from subject-centred to learner-centred.

On the other hand, Pausigere and Graven's (2013) findings analysed in a paper certain key primary mathematics curriculum documents. This was to investigate the primary mathematics teacher identity as constructed by both the previous and current South African education curricula C2005 that projected a therapeutic primary mathematics teacher identity. According to Pausigere and Graven (2013) a therapeutic identity imbues teachers with autonomous, sense-making, integrated modes of understanding and adaptable social practices that create internal coherence. The role of facilitators that were accorded teachers, as the curriculum required, made them shy away from teaching relevant mathematical knowledge. Instead, teachers focused on aspects of learning that promoted accepted societal attitudes, attributes, and competencies of learners. Furthermore, on assessment, Pausigere and Graven (2013) found that evaluation of learners was continuous, portfolio-based, and formative because propriety was given to everyday knowledge. Everyday knowledge occurs when teachers understand implementation from societal needs, based on the opinions of society; and knowledge distribution is horizontal (Khoza, 2015a; Ngubane-Mokiwa & Khoza, 2016a). In mathematics, therefore, putting more effort into everyday knowledge and ignoring subject-specific content undermined the teachers' expert understanding of mathematics as a subject. Pausigere and Graven (2013) agree that the primary teachers' mathematics identity during the enactment of C2005 was weakened. Even if these teachers were mathematics specialists and had extensive knowledge of the subject, that specialisation was no longer relevant. Learners were regarded as the masters of their own learning; their environment informed their knowledge and understanding of mathematics.

The other factor that resulted in the weak understanding of teachers was that formative continuous assessment was promoted (DoE, 2002) over summative assessment. This amounted to weak evaluative criteria, having multiple assessment criteria, emphasising ways of knowing, rather than acquisition of knowledge. Khoza (2016a) adds that assessment is mostly about what is present, or what the learners have achieved, even if it is from their local contexts, not what the students should have achieved through learning correct/valid mathematical concepts as determined by international standards. Prioritising social and political redress of the past rather than progressive mathematical understanding weakened both the subject and the teachers' understanding (Pausigere and Graven, 2013). This is arguably true because teachers were excited that they were regarded as facilitators, not teachers. This misinterpreted decision saw performance of mathematics taking the downward spiral with underperformance being on the rise. The ongoing implementation challenges and pressure from society at large led the then Minister of Education in 2000 to appoint the Ministerial Review Committee. The review

committee recommended a major revision of the curriculum in order to make it more understandable in South African classrooms. “This led to the first curriculum revision: The Revised National Curriculum Statement Grades R-9 and the National Curriculum Statement Grades 10-12, 2002” (DBE, 2011a, Foreword by Minister). Challenges continued which led to in 2009 to the revision of the RNCS Grades R-9 and NCS Grades 10-12. The two curricula were combined in a single document called the national curriculum statement (NCS) Grades R-12 (DBE, 2011a).

1.7.6. The National Curriculum Statement Grades R-12

Despite all these processes and documented explanations of curriculum development in South Africa post-1994, there still lurks a misconception by various scholars that the curriculum and assessment policy statement is the South African curriculum. There are still statements that attempt to justify CAPS as a single South African document or as a refinement of the NCS (Chetty, 2015; Ramollo, 2014; The Star, 2 July, 2012; du Plessis & Marais, 2015; Moodley, 2015; Kokela, 2017; Engelbreght, Nel, Nel and Tlale; 2015, to name a few). These misconceptions indicate that there is a gap when it comes to curriculum understanding and interpretation, especially with researchers, which leads to the already confused teachers becoming more confused. Therefore, correctly positioned, the current South African curriculum is the national curriculum statement (NCS) Grades R-12, not the curriculum and assessment policy statement (CAPS).

Throughout these curricular developments, the South African curriculum was and continued to be built on the values inspired by the aims of the Constitution of the Republic of South Africa (Act 108, 1996) as mentioned in the ‘foreword by the minister’ section of each subject CAPS. These aims are to “heal the divisions of the past and establish a society based on democratic values, social justice and fundamental human rights; improve the quality of life of all citizens and free the potential of each person; lay the foundations for a democratic and open society in which government is based on the will of the people and every citizen is equally protected by law; and build a united and democratic South Africa able to take its rightful place as a sovereign state in the family of nations” (DBE, 2011a, p. iv).

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The general aims of the South African curriculum, the national curriculum statement (NCS) Grades R-12 are to “ensure that children acquire and apply knowledge and skills in ways that are meaningful to their own lives” (DBE, 2011a, p. 4). Furthermore, the curriculum aims to produce

learners who are able to "identify and solve problems and make decisions using critical and creative thinking; work effectively as individuals and with others as members of a team; organise and manage themselves and their activities responsibly and effectively; collect, analyse, organise and critically evaluate information; communicate effectively using visual, symbolic and/or language skills in various modes; use science and technology effectively and critically showing responsibility towards the environment and the health of others; and demonstrate an understanding of the world as a set of related systems by recognising that problem solving contexts do not exist in isolation" (DBE, 2011a, p. 4).

The NCS Grades R-12 serves the purpose of "equipping learners, irrespective of their socio-economic background, race, gender, physical ability or intellectual ability, with the knowledge, skills and values necessary for self-fulfilment, and meaningful participation in society as citizens of a free country; providing access to higher education; facilitating the transition of learners from education institutions to the workplace; and providing employers with a sufficient profile of a learner's competences" (DBE, 2011a, p.14).

Again, the NCS Grades R-12 is underpinned by the principles of social transformation, active and critical learning, high knowledge and high skills, progression, human rights, inclusivity, environmental and social justice, valuing of indigenous knowledge systems and credibility, quality and efficiency (DBE, 2011a). There is no separate NCS document detailing all the above information; however, such is included in the foreword by the minister in Section 1 of each subject of the curriculum and assessment policy statement (CAPS). CAPS is one of the policy statements of teaching and learning which is specific for each subject; including the policy documents, the national policy pertaining to the programme and promotion requirements (NPPPPR) of the NCS Grades R-12; and the national protocol for assessment (NPA) Grades R-12 (DBE, 2011); represented in the NCS Grades R-12. It is against this background that the intended curriculum of the Republic of South Africa is adopted.

1.7.7. The NCS Grades R-12 mathematics CAPS

Currently, in South Africa, the CAPS for each approved subject, as listed in the NPPPPR of the NCS Grades R-12 (2011b), to be taught is entailed in the NCS with a separate policy document for each subject. For the purpose of this study, the intended curriculum is the mathematics CAPS, foundation phase Grades R- 3, with a special focus on Grade 3. In a report that provides an

overview of the key findings of the research conducted in Gauteng and KwaZulu-Natal on the quality of teaching and learning of mathematics and science in schools, the Centre for Development and Enterprise argues that, although the quality of the schooling system in South Africa is poor with low literacy and numeracy levels; the CAPS is highly structured, and regarded as the most important component of this curriculum model (Development and Enterprise, 2014).

Decision-making on what should be included as worthy of learning is a collaborative effort by stakeholders in education. Such includes politicians, government officials, curriculum developers and specialists, representatives of teacher unions, non-governmental organisations, traditional leaders, university-based intellectuals and other stakeholders whose interests are in education matters (Khoza, 2014; Deng, 2010; Chisholm, 2005; Crosswhite *et. al.,* 1986). The intended curriculum, after being approved, is then disseminated to teachers for implementation, which then translates to the implemented curriculum.

In 2011, the C2005 curriculum was amended to the National Curriculum Statement Grades R-12 and disseminated for incremental implementation starting from 2012. Implementation began in Grades R-10 in 2012 and in Grade 12 in 2014. The main component of the NCS Grades R-12 is the CAPS for each recognised and approved subject in South Africa, e.g., CAPS Grades 1-3 mathematics. Contrary to C2005, CAPS for each subject is more specific, indicating what content to be taught, and how to teach and when to teach it, which is typical of Tyler's approach to curriculum. In C2005 there was evidence that in the Mathematics C2005 Grade R- 9 document, content was clearly specified, e.g., pages 14-31 for Grades R-3 (Department of Education, 2002). However, what is missing in the content is the progression of content per term, as outlined in the current mathematics CAPS; therefore, pacing of content was not specified.

On the CAPS foreword (DBE, 2011, foreword page), the Minister of Basic Education, Ms Angie Motshekga, presented that the reasoning behind reforming the curriculum from C2005 to NCS Grades R-12. NCS Grades R-12 was developed by combining the strengths of both the RNCS Grade R-9 and NCS Grade 10-12 with the aim of providing a clearer specification of what is to be taught and learnt for each term. The CAPS curriculum for each subject is dependent on prescribed content for that subject per phase, which makes it a content and educator centred. This therefore suggests that CAPS is a performance curriculum.

In performance curriculum, what learners learn, is controlled by the teacher because as alluded earlier, it is more subject-orientated and characterised by high levels of understanding. Based on Hoadley and Jansen's (2013) evaluation, the performance curriculum is more specific about what is to be taught and in what order it is to be taught. According to Bernstein (1975), in a collection-type curriculum content is of high status and clearly bounded, with various content separated. In agreement, Khoza (2016a) adds that in performance, vertical, or collection curriculum each subject or discipline is independent from each other, with core concepts and skills specifically for that subject and content progressively increasing each term per grade. The content and educator-centred learning takes place in a formal learning environment, which is mostly the school environment (Hoadley & Jansen, 2013). Furthermore, learners have to master the prescribed content for the term in order to meet the assessment requirements for the subject as each subject is assessed separately. A performance curriculum thus demands teachers who have expert understanding because of the specialised language of the curriculum. Despite the demands of the NCS, teachers seemed to have fewer challenges compared with the C2005, until COVID-19 hit the world.

1.7.8. The aftermath of COVID-19 on the national curriculum

According to the data held by the World Health Organization [WHO], COVID-19 is the disease caused by a new coronavirus called the SARS-Cov-2, following a cluster of cases of 'viral pneumonia' in Wuhan, People's Republic of China (WHO, 2020). COVID-19 has over 241 411 389 confirmed cases of infection, with over 4 912 112 confirmed deaths and over 6 545 309 084 vaccine doses administered. On 30 January 2020, the World Health Organization declared the outbreak of coronavirus a public health emergency of international concern. On 11 March 2020, COVID-19 was declared a pandemic (Cucinotta & Vanelli, 2020). When the COVID-19 crisis reached its peak, there was a sudden closure of schools that resulted in rapid national shifts to replace face-to-face teaching with various forms of ICT-based, remote, and distance education (United Nations Educational, Scientific and Cultural Organization, 2021).

During the unprecedented times of COVID-19 globally, at the peak of the pandemic, teachers' understanding of the implemented curriculum was again tried and tested. One of the major curriculum changes in the South African curriculum was the trimming process. Governments were therefore pressed for time to engineer ways of recovering the lost teaching time due to national lockdown: schools had to put 'implementable' measures in place. For this reason,

countries protected educational goals by ensuring that learners continued to learn. Online learning was about making adjustments to the curriculum content (UNESCO, 2021). In South Africa, to be specific, the school curriculum content across the General Education Bands of DBE was also trimmed. There was a similar trend in higher-education institutions (HEIs). Khoza (2021b) attests to the content for other modules, although it was still prescribed, being reduced because of the limited time for the 2020 academic year.

For basic education, the DBE issued Circular S3 of 2020 (DBE, 2020). The purpose of the circular was to provide guidelines for the implementation of annual teaching plans (ATPs) and the minimum core content and skills per subject and per grade. In the annexures that accompanied the circular, Annexure C−Teacher Guidelines: Implementing of ATPs, General Education and Training (GET) Fundamentals (Core Content and Skills) (DBE, 2020) was found. As alluded to, the DBE is adamant that the document "provides a set of principles to guide teachers as they exercise their professional judgement in the best interests of their learners in their context" (DBE, 2020, p. 2).

The content of Annexure C required teachers to use their expert understanding on what needed to be taught. At face value, teachers seemed to be teaching far less than they had previously been teaching. Some teachers even claimed that the curriculum had been revised, and the content workload reduced (see diagram below) until they received the revised annual teaching plans (RATPs) that were more specific on what they had to teach. The purpose of the revised phase plan and revised annual national teaching plans was to:

> "Ensure that meaningful teaching proceeds during the revised school calendar, assist teachers with guided pacing and sequencing of curriculum content and assessment., enable teachers to cover the essential core content in each phase within the available time., address assessment overload to recoup time loss, assist teachers with planning for the different forms of assessment, ensure learners are adequately prepared for the subsequent year/s in terms of content, skills, knowledge, attitudes, and values." (DBE, 2020b, p. 4)

These interpretations of the curriculum trimming were evidence that teachers had moved from their comfort zone unexpectedly and were unconsciously assuming that the curriculum had been revised. The other factor may be that these teachers were not mathematics specialists, nor did they have qualifications in teaching mathematics. Molapo and Pillay (2018) posit that teachers' qualification in a subject has a huge impact in positioning them as experts; also, for productivity and improved learner performance. Below is what the trimmed curriculum looked like when it was sent to schools for teachers to implement:

The DBE prioritised what are deemed fundamentals for each subject. In mathematics, for example, DBE prescribed that learners be taught mathematics, numeracy, and number concept development. For an ordinary Grade 3 teacher, the terms mathematics and numeracy may mean the same thing.

Hoadley (2020) points out that the curriculum recovery planning and thinking has been designed in line with the national curriculum with its clear stipulation of content and pacing guidelines. Hoadley (2020) posits that the strength of CAPS as a highly specified curriculum has enabled the Department of Education, schools, and teachers to identify content, concepts and skills that have not been covered. It has also enabled the identification of fundamental concepts, content, and skills in terms of progression, the original stipulation being generally coherent and explicit across grades.

1.8. Structure of the Study

The next section is the structure of the thesis.

1.8.1. First Chapter: Introduction and Background of the Study

This chapter provides the reader with the motivation behind conducting a study of this nature. Firstly, it introduces the study, then gives a background of the study. Additionally, there is a candidate's statement, the rationale for conducting the study, research objectives, and research questions. There is also a section that gives a detailed background and reform of the South African curriculum, starting from Apartheid South Africa to date, when we had to deal with the COVID-19 pandemic.

1.8.2. Second and third chapters: Insights into teachers' expert understanding and focusing the lens onto the common understanding

These two chapters provide a critical discussion of teachers' understanding of the implemented mathematics curriculum based on both their expert and common understanding. The reviewed literature attempts to answer the two research questions from the perspective of existing literature of the study phenomenon. Chapter 2 discussed teachers' understanding as a phenomenon of this study. Then followed a discussion on expert understanding, performance curriculum, objectives, specialised content, teachers as experts, and a summative assessment. Chapter 3 focused on common understanding, a discussion on learner-centred teaching and learning activities, learning environment, and assessment for learning.

1.8.3. Fourth Chapter: The natural identity framework as a framework for teachers' understanding

This chapter presents Khoza's natural identity framework (NIF) as a framework for analysis of teachers' understanding. The three identities; professional, societal, and personal presented in the framework align with there being three propositions of understanding, which are the expert, the common, and the individual understanding. The framework further introduces the natural identity which informed the development of this study's theory.

1.8.4. Fifth chapter: Methodologising teachers' understanding

The chapter discusses the research design and methodology underpinning this study. This study is a qualitative action research, using the pragmatic research paradigm to answer the questions of this study and to validate the findings on the forthcoming analysis chapter. This chapter on research design and methodology further provides a detailed account of how the study at hand will achieve such. It presents the philosophical foundations, ontological, epistemological, methodological, and axiological assumptions of the pragmatic paradigm. It then discusses an action research and its compatibility with the pragmatic paradigm. There is a further discussion on sampling, data generation instruments, and how trustworthiness will be achieved through credibility, transferability, dependability, and conformability. Lastly, the chapter discusses data analysis, ethical issues, limitations of the study, and how limitations will be addressed.

1.8.5. Sixth chapter: Explicating teachers' understanding through reflections and actions, answering the 'what' and 'how' questions

This chapter presents an analysis of findings of generated data from reflective activities, interviews, and observations. These findings are summarised in relation to the objectives and first research question of the study aligning them with the three levels of understanding (expert, common and individual) and the three levels of identities (professional, societal and personal). This discussion will lead to the next chapter.

1.8.6. Seventh Chapter: Addressing teachers' understanding to answer the philosophical 'why' question of the study

This last chapter will present the discussion of findings from each theme of the NIF and the mathematics curriculum. Then, based on the discussions, the second research question is answered in alignment with the natural identity leading to the theory of the study. Conclusions and recommendations of future

research are also presented. The penultimate section of the chapter presents the overall structure of the study and evaluates whether the research questions have been answered. It also provides conclusions on the results and suggestions for further research.

1.8.7. Eighth Chapter: Summary of Findings, Propositions, Implications and Conclusions

The last chapter of this summarises analysis findings, present propositions, implications and the conclusions of the study.

1.9. Location of the Study

The study was conducted in Mpumalanga Province. The sampled teachers are teaching in Nkangala District, KwaMhlanga South-West Circuit. The district itself is huge and diverse; however, the KwaMhlanga South-West is semi-rural. The area has a fair share of a population of both unemployed and employed citizens. Those who are employed work in nearby schools, malls, government complexes, and many perform general work in the area. There is also a cohort of residents who commute daily to and from Pretoria and Bronkhorstspruit for work. Languages spoken in the area are mainly IsiNdebele and Sepedi. The schools in the circuit accommodate learners from various socio-economic backgrounds, from poor socio-economic, working class, to middle-class backgrounds. The circuit does not have former Model-C schools. It offers mother-tongue instruction in the foundation phase, except in the school in which P2 teaches.

1.10. Anticipated Limitations

For this study, the main limitation was time, interruption of school activities, and utilisation of the focus group as a method of data generation. To overcome this, I asked participants to complete reflective activities and to return these via email instead of me travelling to Mpumalanga. To avoid interruption of contact time in schools, the research focusing on teachers, I slotted interviews to take place after school or very early in the morning before school started, i.e., between 07:00 and 07:45. Due to the COVID-19 pandemic, it became difficult to access a group of teachers face to face. Organising a virtual interview was more challenging as some of the participants did not have access to the internet or had little to no knowledge of online platforms. Therefore I replaced the focus group with observation of video recordings of teachers teaching a mathematics lesson in their classes. There was no inconvenience: teachers taught lessons that they had prepared to teach, ensuring that their lessons were video recorded. I then played the videos and observed the teaching. Issues around video recording while learners are in class have been considered; however, it should be acknowledged that the videos were not going to be published, but would be used solely by the researcher for observation and analysis purposes. Videos will be discarded after their time frame of storage has expired**.**

CHAPTER TWO

INSIGHTS INTO TEACHERS' EXPERT UNDERSTANDING

2.1. Introduction

The main purpose of this study is to explore teachers' understanding of the implemented mathematics curriculum. This chapter therefore presents a comprehensive literature review on teachers' understanding of the South African Mathematics Curriculum and Assessment Policy Statement (CAPS). The chapter starts by discussing teachers' understanding as a phenomenon of this study. Secondly, special focus was on the expert understanding of the curriculum as explored by scholars who specialise in curriculum matters.

Curriculum implementation is a representation of curriculum for teachers who are the main users. Implementation of curriculum occurs when teaching and learning take place (Van den *et al.*, 2009). As Polly (2017) posits, it is during the implementation phase that each teacher has the autonomy to modify the curriculum in their classrooms, deciding what to incorporate or discard; and how to teach activities from the same curriculum. The intended curriculum concerns intentions of policy makers and curriculum developers at the developmental or design level nationally: such are found in curriculum policy documents. Curriculum at the design level includes the national policies detailing subjects to be taught, content that learners are to learn, reflecting visions or rationale, aims, teaching methods, time allocation and assessment, both formal and informal (Booyse & Du Plessis, 2014; Khoza, 2014; Deng, 2010). Therefore teachers, as frontline implementers, have the responsibility of ensuring that the curriculum is implemented as planned in schools, especially in countries that use a national curriculum as in South Africa. These expectations by authorities on teachers position teachers as experts, hence the demand to explore their capacity of understanding at the level of experts.

This responsibility is, however, not always possible − teachers at implementation level make decisions while teaching. In essence, the success of implementation also depends, to some extent, on how teachers understand the curriculum, because it is at the implementation level that teaching and learning take place. Molapo and Pillay (2018) conducted qualitative research seeking to understand educators' experiences when implementing CAPS; how they were taken on board for CAPS implementation, and the challenges they encountered during implementation.

Their findings confirm that, in South Africa, after the introduction of CAPS, implementation challenges have been identified and continue to be the main contributing factor in poor teaching and underperformance. The findings, on one hand, further indicated that teachers who had more challenges in implementing the CAPS were those with a low qualification in teaching. On the other hand, those who were optimistic and had fewer or no challenges had a master's degree or higher qualifications. Based on this, it is clear that highly qualified teachers have fewer challenges in implementing the curriculum, which positions them as experts.

Literature review is then a starting point for exploring teachers' understanding as a phenomenon of this study. A construct which this literature is following is outlined in Figure 1 below. The next section therefore unpacks the significance of expert understanding of mathematics informed by the current South African mathematics CAPS in relation to its objectives, content, roles of teachers, and summative assessment.

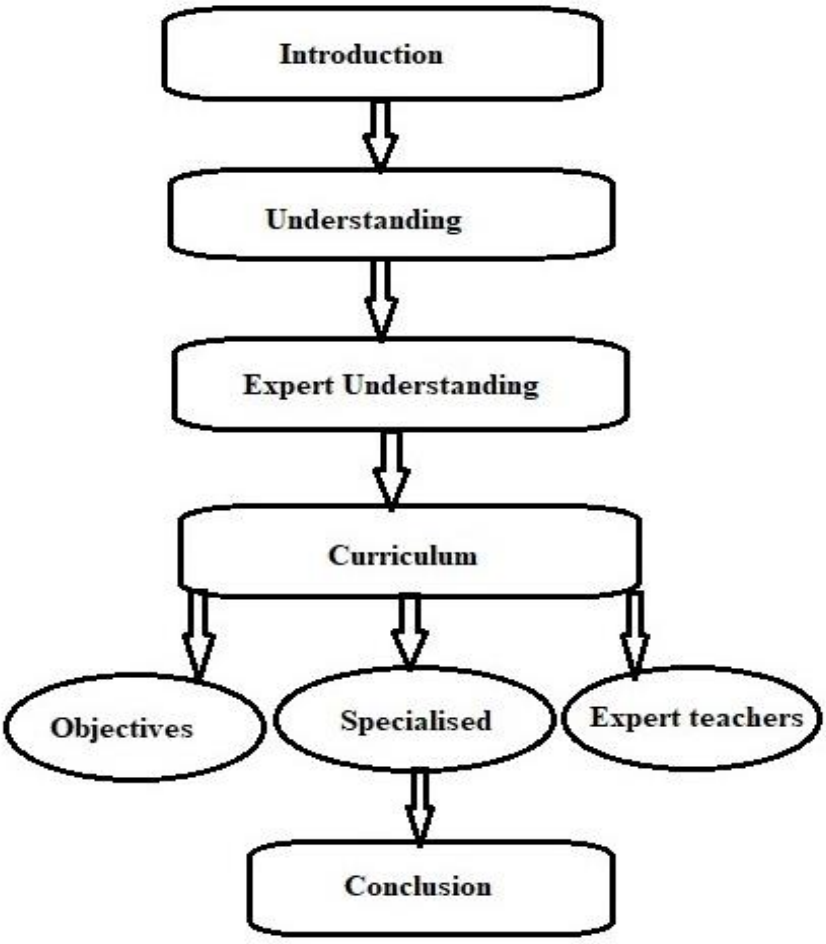


Figure 2.1: Insights into teachers' expert understanding

2.2.Teachers' Understanding as a Phenomenon

Research on school curricular matters has indicated that understanding plays a major role in the implementation of reform ideas (Carless, 1998; Thompson, 1984; Vandenberghe, 2002). Thompson (1984) posits that knowledge and skills are necessary elements of understanding, yet insufficient in themselves. Understanding, as a phenomenon, is a "dynamic and continuously unfolding phenomenon" (Martin & Towers, 2003, p. 245); a psychological process that requires a person's ability to do the work thoughtfully and actively with discernment, as well as the ability to self-assess, justify, and critique such. In other words, understanding, being a psychological process, may take a long time to acquire. Understanding is therefore a cognitive process, driven by experience to bring new actions. Whoever understands is able to distinguish, explain, interpret, and summarise data (Khoza, 2016). In curriculum implementation, understanding plays a critical role, as the schooling system itself needs and depends upon the work of expert teachers who understand their subjects.

Understanding a subject involves learning its content, conceptual framework, and ways of thinking (Schiro, 2008). In his study, Shulman (1986) further points out that knowing a subject for teaching requires more than knowing its facts and concepts. Therefore, teachers need also to understand the principles that underpin the subject, its structures, and the rules for establishing what is legitimate to do and say in a field. Teachers, according to Shulman (1986), are expected to understand why a given topic or certain content is particularly central to the subject, whereas another may be somewhat overlooked. To represent their understanding of curriculum, teachers must not only understand the operational 'what' part, but also the philosophical 'why' (Shulman, 1986). This type of understanding of curriculum may differ from teacher to teacher and may even influence how teachers teach, each one having his or her own beliefs, identities, and unique ways of interpreting mathematics; actions are informed by the knowledge teachers bring to their practice (Güneş & Baki, 2012; Carpenter, Fennema & Franke, 1996, Moru, Qhobela & Maqutu, 2014). Understanding in itself is not a universal phenomenon − it is unique for each individual.

Synthesising the above definitions, understanding is therefore a planned, prescribed system of presenting one's thoughts and expertise regarding a particular subject. These thoughts are informed by knowledge, skills, values, and experience of their practice. Dewey (1910, p. 1) adds that "everything that comes to mind, that 'goes through our heads', is called a thought. To think of something is just to be conscious of it in any way whatsoever. Thoughtfulness means, practically, the same activity as careful attention". Hence the notion that teachers who are

implementing the same prescribed mathematics curriculum may have varying understanding because their thought structures are different; their experiences and perhaps their knowledge and skills acquired for that particular subject also vary. Jansen (2004) adds that, to some extent, teachers' varying understanding is influenced by the visions of policy makers at design level and how teachers identify with these prescribed visions (Jansen, 2004). These conflicting views of what constitutes teachers' understanding indicate the gap that is out there at the implementation level of curriculum. Therefore, in this study, an exploration of Grade 3 teachers' understanding of the mathematics curriculum is used as a benchmark which informs how they are implementing it, and what informs their implementation of curriculum the way it does.

From the above definitions and interrogations of understanding, it may be argued that there is no absolute understanding, be it in education, nursing, engineering, and all other disciplines. Even in our day-to-day engagements we do not understand activities identically. Khoza (2016a) conducted an interpretive case study, with the purpose of exploring the postgraduate students' understanding of curriculum visions and goals in teaching their subjects. In the study, Khoza (2016a) noted with concern that teachers' lack of understanding of the curriculum and its visions continues to be a thorny issue within the boundaries of the South African education landscape; because successful implementation of curriculum depends on this understanding. Understanding, according to Khoza (2016a), also empowers teachers by enabling them to reflect on their teaching in order to improve their teaching practice. Therefore for the teachers to be able to implement the curriculum, they have to understand the principles underpinning the curriculum, its aims and objectives, how the mathematics content is organised, the kind of experiences learners should be exposed to, and how this content is evaluated. This is not a ready-made package that teachers bring along from teacher education − teachers acquire, learn, and reflect on such as they continue on their journey of teaching.

There are two major divisions of understanding as identified by researchers such as Shulman (1986); Skemp (1986); Ernst (1989); Bernstein (1999); Jansen (2004); Schiro (2008); Khoza (2015a); Khoza (2016a & b). These categories include both professional and societal understanding. This study classifies such as either expert or common understanding. However, this chapter deliberates on the expert understanding; the next chapter (Chapter 3) discusses common understanding. Thereafter, Chapter 4 discusses the gap that emerged from the two divisions of understanding, producing the framework for this study based on teachers' personal understanding.

2.3. Expert Understanding

Expert understanding is aligned with the discipline, subject, curriculum or professional needs (Khoza, 2015a). Teachers who have expert understanding rely more on understanding facts related to their subject, specific content of the particular subject, specialised assessment requirements and their professional roles as teachers. Of importance also is the teachers' level of qualification and specialisation in the subject; because if teachers are specialised to teach the subject, it is likely that they will also excel in teaching the subject, knowing and understanding the content. However, Moru *et al.*, (2014); Centre for Development and Enterprise (2014)'s findings revealed that in the early grades of schooling, most teachers are either unqualified or underqualified to teach the mathematics that they are expected to teach. Teachers obtained either a certificate or a diploma which qualified them to teach; however, not to specialise in teaching mathematics. The Centre for Development and Enterprise, (2014) acknowledged that in South Africa there is a shortage of qualified teachers to teach mathematics, amongst other subjects. The findings do, however, indicate that there is a lack of a significant relationship between teachers' qualifications and how learners perform and the qualifications' effect on the experience of teachers. These findings are contrary to the findings of Molapo and Pillay (2018), who posit that the higher the teacher's qualification, the more productive and better results they produce. Notwithstanding these findings, teachers do, however, need to be grounded in expert mathematical understanding to be able to interpret the foundational and theoretical position of mathematics. Such will enable them to implement the curriculum according to the given prescripts.

Findings from Mabuza's (2018) study aimed at exploring educators' reflections on Swaziland's Junior Secondary Integrated Consumer Sciences curriculum reveal that "Consumer Sciences teachers' rationale for teaching is greatly informed by demands of the discipline internationally, as per their training and a need from the public to impart hands-on skills to learners" (p. xvi). Despite imparting hands-on skills in consumer studies, the teaching of this subject demands expert training and understanding. Similarly, findings of Khoza's (2015a) interpretive case study on student teachers' reflections on their practices of CAPS, revealed that most teachers implement the curriculum based on what the CAPS requires them to do; therefore reasons for teaching were based on expert understanding. The study concluded that teachers work like technicians. Technicians do not deviate from the manual given to them. They follow step by step every aspect of what they are fixing. This does not need them to apply their prior knowledge or experience, but their ability to read, understand and follow the instructions. Similarly, teachers

are given a curriculum policy to follow when implementing the curriculum (expert). Van Manen (1977) agrees that when teachers implement the curriculum with the aim and concern of achieving predetermined objectives, this is correctly positioning them in the technical (expert) perspective of understanding. When teachers implement curriculum as a prescript, it is believed that these teachers will be able to manage their classes because of the way in which the curriculum content is structured. This will lead to teachers achieving the set goals, having time to reflect.

Bernstein (1999) refers to such as vertical, school, or official knowledge because the curriculum is coherent, explicit, and with a systematically principled structure. Skemp (1976) further adds that expert or instrumental understanding promotes proper teaching. Such is based on a fixed plan of what to teach, what to learn, and what to assess. The curriculum provides no room for deviation, as what is to be done is provided. Furthermore, Bernstein (1999) qualifies his viewpoint by indicating that understanding of this nature is hierarchically organised, having strong distributive rules regulating access (who), transmission (how), and evaluation (assessment). This viewpoint resonates with that of Khoza (2016) that, in professional or expert understanding, each subject or discipline is separate from other subjects and uses subject-specific terminologies or concepts. This is driven by identified content, in which all teachers teach the same body of knowledge from the lowest to the highest levels of the cognitive domain. This type of understanding is vertical and hierarchical in nature. This means that when teachers have this type of understanding they know that teaching the content of mathematics moves from the concrete to the abstract, as it is in the current mathematics CAPS that content progresses from the simple, low number sequences, ranges, and patterns to higher ranges per grade per term.

Hadebe-Ndlovu (2017), in her study that explored Grade 1 teachers' understanding of their pedagogic practices, asserts that teachers must understand the mathematics topics which form part of the mathematics content stipulated in the mathematics CAPS. This type of understanding, she argues, will help teachers to plan detailed lessons that are logical and helpful in advancing learners' progress in mathematics. The strength of expertise lies in teachers' understanding of subject objectives, content, their roles as experts, and in summative assessment. These strengths may be achieved when teachers understand the curriculum which is discussed in the next section.

2.4.Understanding the Performance Curriculum

The word curriculum originates from the Latin word 'currere', which means to run a course (Hoadley & Jansen, 2013); currere is interpreted by Van den Akker *et.al.* (2009) as a course for learning in an educational setting. Khoza (2018); Berkvens *et al.* (2014); ÇÌL and ÇEPNÌ (2014); Hoadley and Jansen (2013) and Van den Akker *et al.* (2009) concur that there are three levels on which curriculum distinction or representations can be made in a teaching and learning situation. These levels are the intended, implemented, and the attained curriculum. The definition of curriculum may be narrowed; however, one should contextualise the definition according to the needs of the study or the purpose for which the curriculum will be used. Is the focus of the study on the intention (intended), on the action (implemented), or on the product (assessed)?

For the purpose of this study, the focus is on the implemented curriculum; however, the discussion starts on intended curriculum which is the foundation of the implemented curriculum. For implementation to happen, a plan (intention) should be available. The attained curriculum is also briefly described, being that which informs whether the curriculum aims and objectives have been met; and if not, it informs reform. Furthermore, the success of the attained curriculum lies in the implemented curriculum. For this reason, Glatthorn *et al.* (2012) posit that the word curriculum should reflect the general understanding of the term as used by teachers and be useful to them in making operational distinctions. This implies that teachers, as implementers at school level, should be able to interpret and understand curriculum in a way that enables them to position themselves and their roles as implementers in the process of curriculum development; thus teachers enable learners to achieve the end results. As alluded in an earlier discussion, in curriculum, the choice of interpretation and usage of words is a reflection of the user's perspective (Hewitt, 2006); but of note is a special role that the teacher plays as an expert.

Therefore, Kelly's argument (2009) that curriculum should be defined taking into consideration four dimensions is maintained. These dimensions, according to Kelly (2009) are the intentions of the planner; the procedures adopted for the implementation of these intentions; the experiences of pupils resulting from the teacher's direct attempt to carry out their or the planner's intent; and the hidden learning that happens as a by-product of the organisation of the curriculum, and of the school. Kelly's (2009) position is observably informed by what is well known as the Tyler Rationale. According to Tyler (1949), the provision of a curriculum by any developer of curricula should be based on four significant questions which Tyler (1949) deems fundamental in curriculum development. Firstly, what educational purpose should the school seek to achieve?

Secondly, which educational experiences can be provided that are likely to be successful in achieving this purpose? Thirdly, how can these experiences be effectively organised? Lastly, how can we determine whether these purposes are being attained? According to Tyler, the type of curriculum aligned with this rationale is therefore logical, following a step-by-step process of achieving curriculum goals.

Kelly (2009, p. 13) defines curriculum as "the totality of the experiences the pupil has as a result of the provision made". Therefore this definition should enable teachers to start understanding the curriculum from what the designer intended should be included in the curriculum, also understanding why this is so. This speaks to the content and objectives of the curriculum. Secondly, procedures to be followed and how these must be followed when implementing the curriculum would translate to their roles as teachers. Then, how will teachers ensure that their teaching yields positive results for learners, which is mostly the result of assessment?

A view of curriculum as an intention is defined as "a plan for teaching" (Van den Akker *et al.,* 2009, p. 9); "a plan for teaching and learning" (Khoza, 2018, p. 2) and an intention, plan or prescription (Stenhouse, 1975). The intended curriculum is also referred to as the "…planned, prescribed, official or formal curriculum" (Khoza, 2018, p. 3). At this level of the curriculum, broad curriculum goals are stated with the aim of schooling being to create critical and creative thinking in learners. The intended curriculum provides a broad overview of what the national curriculum aims to achieve, and the type of learner to be produced at the end of the schooling system. The intended curriculum also provides details of the subjects to be taught or skills that will be developed in learners by each subject. Content is also packaged in a coherent manner, which shows progression from term to term or from grade to grade as in the foundation phase mathematics CAPS.

Currently, the SANC Grades R-12 (Section 1), incorporated into the foreword of CAPS for each subject serves that purpose. In CAPS Mathematics Grades 1- 3, Sections 2 and 3 have specific aims, content, and clarification notes (guiding the teacher on how to teach specific content). In Section 4 there are guidelines on assessment, both summative and formative. However, the curriculum is more prescriptive on how many summative assessment tasks must be administered per term, and how these should be administered. A report provides an overview of the key findings of the research conducted in Gauteng and KwaZulu-Natal on the quality of teaching and learning of mathematics and science in schools. The Centre for Development and Enterprise

argues that, although the quality of the schooling system in South Africa is poor with low literacy and numeracy levels, the CAPS is highly structured; such is regarded as the most important component of this curriculum model (Development and Enterprise, 2014).

These broad definitions of curriculum affirm the notion that the curriculum is a complex and controversial phenomenon in that its decision-making process has technical, practical, and political implications, with the various types of curricula (Pinar, 1995 & Johnson-Mardones, 2015). These definitions and conceptualisation of the curriculum further explicate a link between what is to be taught, the teachers, and the learners. This implies that one cannot happen without the other. What is to be taught in school is informed by the intentions of policy makers at national level. This content is for teachers to implement at school level and for learners to learn and be assessed on. Thus, one can evaluate whether or not the curriculum has achieved its goals. Furthermore, the intended curriculum can either be based on a competence or a performance curriculum model.

This chapter is, however, discussing only the performance curriculum, as CAPS is a performance curriculum model. The competence curriculum was discussed in detail in Chapter One. An argument of CAPS being regarded as a performance model of curriculum is that, as mentioned earlier, what is to be taught, how it will be taught and assessed, is explicitly stated in the curriculum documents.

According to Bernstein (1975), in the performance-type curriculum, content is of high status; all content is clearly bounded and separated. In agreement, Khoza (2016a) adds that, in performance, vertical, or collection curriculum, each subject or discipline stands on its own, and has its own collection of terminologies/concepts which are presented by content that is specific and hierarchical in order. Performance curriculum therefore demands that teachers have expert understanding of the curriculum. The next section discusses how teachers understand mathematics curriculum objectives: the content, their roles, and how to assess.

These key curriculum concepts were explored by van den Akker *et al.* (2009), Khoza (2015 & 2016), Fomunyam (2014), and Shulman (1987), who provided insights into the key concepts of pedagogic, content knowledge, and the concepts teachers use in teaching. Van den Akker *et al.* (2009) and Berkvens *et al.* (2014) title these concepts of curriculum a curricular spider web; and Khoza (2015a) called this learning signals. Khoza (2015a) posits that the learning signals are basic pillars of teaching and learning; and that it is imperative that teachers have an

understanding of how these signals are interrelated for successful curriculum implementation. Hence, teachers need to have expert understanding of curriculum objectives.

2.4.1. Expert understanding of objectives

Specification of objectives in curriculum and subjects has, over the years, been influenced by Ralph Tyler's model of curriculum that has determined the study of curriculum. This model is underpinned by four questions that are dubbed 'The Tyler rationale'; which Tyler regards as critical when developing a curriculum. These four questions, as alluded in the previous chapter,, are: What educational purpose should the school seek to achieve? Which educational experiences can be provided that are likely to be successful in achieving this purpose? How can these experiences be effectively organised? How can we determine whether these purposes are being attained?

However, the first question seems to be the core of this rationale in that Tyler asks about the educational purpose of the curriculum/subject/school and what it seeks to achieve (Tyler, 1949). This question, easy as it may sound, demands answers to why, for example, we need a mathematics curriculum. Why can we not just go to class, teach learners from memory, and progress them to the next grade? What are the objectives of developing a particular subject curriculum? This model is called by some scholars the objectives model; such suggests that it is focused on or promotes the performance curriculum. Null (2011) cautions that the Tyler rationale is designed to be used by any curriculum worker: the questions he asks should not be treated as a rigid model to be followed by curriculum developers.

Objectives are important in a curriculum (Lunenburg, 2011) and are consciously willed goals that become criteria of selecting content to be taught, resources, learning activities and assessment planning and administration (Tyler, 1949). Wilson (2014), Kennedy *et al.*, (2006), and the University of Technology Sydney (undated) define objectives as detailed concrete statements that inform what will be taught and what learners are expected to learn in a particular subject at the end of the lesson, year, or phase. However, Kennedy *et al.* (2006) noted that objectives are sometimes used by teachers as a plan of teaching and at other times as a plan for learning. Kennedy *et al.* (2006) argue that these conflicted understandings of how objectives should be used, causes tension in concluding whether objectives belong to the teacher-centred or the learner-centred approach. Khoza (2013) clarifies the matter by maintaining that objectives

are better suited to the teacher-centred approach (behaviourism) because teacher-centred approaches are effective for presentation of objectives. James (1999) adds that, when developing objectives, a subject specific approach should be employed. Therefore, an understanding that subjects have their specialised content that is coherent, with clearly stated overall aims, is evidence enough that objects are in the expert continuum of curriculum.

Khoza (2015a) maintains that objectives are created according to the teacher's intentions rather than intentions of the learners. Therefore, the autonomy of the teacher suggests that objectives are more aligned with a performance curriculum. In agreement, Galane (2016), in a critical action research aimed at exploring subject advisors' reflections on their supervision of the mathematics curriculum concur that teachers should understand the aims of the subject or curriculum so that they are able to set clear achievable objectives.

Mabuza (2018) explains that objectives are short-term goals that emanate from aims. These goals signify what teachers must do towards achieving the aims of the curriculum. Objectives are an important component of a performance curriculum − through objectives, curriculum developers or policy makers are able to gauge whether the curriculum has met its goals and aims. Stenhouse (1975), although not a proponent of performance curriculum, cannot help but acknowledge the powerful nature of objectives in curriculum in that objectives provide a systematic focus.

According to Tyler (1949), the rationale for selecting objectives is key − it informs the aims of the plans of education. Secondly, setting up objectives is important as it informs the content, resources, teaching and learning activities and assessment of the curriculum. In agreement, Marsh (2009), in his book, *Key Concepts for Understanding the Curriculum*, points out that objectives play an important role in the planning process for teachers, providing answers to what learners learn and what teachers have to teach. Furthermore, Marsh (2009) maintains that objectives are likely to lead to improved learner performance because they help both the teacher and the learner to focus on what will be assessed. Lunenburg (2011) explains that development of objectives is dependent on the overall goals of the curriculum. Goals are developed to provide consistent focus on the curriculum. For teachers to be successful in developing subject objectives, they must first understand the aims of a curriculum. James (undated) stresses that teachers must use subject-specific approaches to developing objectives. According to James (undated) this resonates with the stance of Tyler (1949) that subject-specific approaches help the teacher to plan the content of what to teach, how to teach it, resources that will be needed, and

how learners will be assessed. The way in which objectives have been developed is reflected in the learners' performance in any particular subject.

Adagale (2015) posits that objectives should be developed from the simplest to the more complex; and Tyler (1949) agrees that objectives should be developed at a more general level. In education, objectives have different meanings for different people; however, education is a process of changing behaviour patterns of people (Tyler, 1949); hence objectives are identified by Wilson (2014) and James (undated) as behavioural objectives. The patterns Tyler identified are thinking, feelings, and actions. Wilson calls these specific domains the cognitive (head), affective (heart), and physical (hand). James argues that limiting objectives to behavioural objectives is beneficial in that the approach retains a balance, being neither too vague nor too precise. Furthermore, the results are outright observable. Therefore, developing behavioural objectives will determine the kinds of changes in behaviour that a subject seeks to bring forth in its learners. The envisaged learner is the one who has a changed behaviour at the end of learning, which means that the desired objectives have been met.

To achieve the desired objectives, learners should be made aware of what is expected of them. Achievement is dependent on clearly stated objectives that are measurable (Adagale, 2015 & van den Akker *et al.*, 2009). Clearly stated objectives, according to Tyler (1949), have two dimensions: behaviour and content. For this reason, objectives can be stated in such a way that they identify both the kind of behaviour to be developed in the learner and the content in which this behaviour is to operate, e.g., in Grade 3 Mathematics CAPS (DBE 2011a, p. 75) "learners are expected to: solve (behaviour) money problems involving totals and change in rands or cents (content)". It is evident that objectives cannot be separated from content and assessment, with the teacher as a driver, as alluded to by all researchers alike (Tyler, 1949; Marsh, 2009; Lunenburg, 2011 Khoza, 2013 & 2015a; Adagale, 2015; Mabuza, 2018 & James (undated)).

In a study conducted by Khoza (2015a) on student educators' reflections on their practices of CAPS, the researcher noted that the mathematics CAPS presented objectives as specific aims. Therefore, to be able to teach effectively, teachers need understand expert understanding of the subject learning objectives as stipulated in the mathematics CAPS. This is because there is a widespread agreement that objectives belong to the performance curriculum (van den Akker *et al.*, 2009; Khoza, 2015a).

Berkvens *et al.* (2014) and Galane (2016) point out that curriculum objectives can provide teachers with guidelines on the content of the subjects which needs to be taught, and when and how to teach and assess such. Understanding the specialised mathematics content for Grade 3 may make it easier for teachers to know what they should teach in mathematics.

2.4.2. Specialised content

Wood and Hedges (2016) and Berkvens *et al.* (2014) define curriculum content as subject matter knowledge, skills, dispositions, understanding, and values that constitute a curriculum. In any performance curriculum, content is the core: it is in a performance curriculum that content is explicitly and coherently outlined. Mabuza (2018) notes that curriculum deliberations and research on curriculum revolve around content or subject matter. According to Mabuza, content may be presented in many forms, including audio, text, and video. However, in many countries, including South Africa, the curriculum content is mainly presented in the prescribed curriculum documents for each subject. Teachers therefore have the responsibility of internalising this content and understanding it. Teachers should not understand a curriculum as an isolated set of rules and skills.

According to Carrillo-Yañez *et al.,* (2018), specialised content understanding recognises the specialised nature of the teacher's mathematical understanding, which is exclusive to the teaching practice. This is contrary to the understanding of mathematics that other professionals need in their field of specialisation. Therefore, having a high-level mathematics education such as professionals have may be a positive attribute for teachers at the classroom level. Teachers' foundational understanding of the mathematics curriculum content may be supported by the level of mathematics education they have achieved. In addition, Carrillo-Yañez *et al.* (2018) clarify that specialised content understanding is attributed to the quality of mathematics instruction that can be analysed from a number of angles; the kind of knowledge that teachers bring to the classroom and simulate prior to and during teaching. This can have an important influence on learners' engagement with mathematics concepts and problem-solving skills. Therefore, allowing quality of teaching that learners receive in their mathematics classroom is surely featured as a significant factor that could impact on learners' learning and development of mathematics proficiencies. It should be noted that there is a high possibility that quality teaching may take place if teachers understand the content they have to teach as experts.

According to Boys and Spink (2008), mathematics is a coherent network of organised ideas and skills that must be carefully developed in learners and should be understood as such. Given the nature of mathematics, this type of mathematics understanding positions teachers as experts because the content is not designed by them − they have to master it. There is a widespread belief that to teach the content of the intended curriculum, teachers require strong subject matter knowledge; and that teachers who know more, teach better (Paulson, 2001). Murray *et al.* (2018) agree that higher mathematics courses have a positive impact on teachers' understanding of content. This means that, at institutions of higher education, teachers should be offered mathematics courses that complement the mathematics content in the intended curriculum. There will then be synergy between what teachers have learnt and know, and what they are expected to teach as per curriculum prescripts.

Schmidt *et al.* (2017) agree that colleges and universities equip teachers with academic qualifications that prepare them to teach specific content in specific grades. However, evidence from literature reviewed and findings from their study indicate that in the first year of teaching, teachers who are well-qualified grapple with issues of classroom management, and acclimatising to the teaching conditions and the teaching of the content in which they specialise. This leads them not to meet the objectives of the curriculum. Teachers only start improving from the second year onwards, gradually becoming the best of teachers. Therefore in spite of their qualifications as expert mathematics teachers, some novice teachers find it difficult to cope in the first year of teaching. Such may lead some teachers into being discouraged, doubting their worth. This later develops into continuous underperformance, leading studies to conclude that there is lack of a significant relationship between teachers' qualifications and how learners perform; and the effects of qualifications on experience of teachers and their understanding of mathematics (Centre for Development and Enterprise, 2014). The latter statement therefore nullifies the importance of having a mathematics qualification to be an expert teacher. This contradicts experiences in the teaching of mathematics in South Africa.

Reflecting on the mathematics landscape in South Africa during the Apartheid era, mathematics teacher education was racialised; African teachers were provided with inferior mathematics education. Their becoming experts in the teaching of mathematics was then compromised. The mathematics syllabus for primary schools up to Standard 2 was taught in mother tongue, and generally by unqualified or underqualified teachers. It should be noted that teaching learners in the context of mathematics and other content subjects, learners being taught in their mother-

tongue should not be regarded as a problem. The problem only emerges when teachers are unqualified, are not able to correctly articulate mathematical concepts; or when teachers cannot use the correct mathematical language at the level of the learners they are teaching. This position resonates with the findings of Seroto (2000) that, although mathematics was one of the key subjects to be taught, the curriculum developers did not include it in the two-year Native Higher Primary Certificate curriculum in 1944, only doing so later, in 1946. The reason for not offering arithmetic for teacher training was the assumption that Black people may not have the capacity to learn scientific subjects. This resulted in arithmetic being taught by unqualified teachers or those qualified in teaching but not specialising in the subject.

Content that was taught at teacher training for teachers at primary level has been identified by Seroto (2000). Such content included basic counting, symbols and their utilisation when conducting basic addition, subtraction, multiplication, division, and reduction of the more common weights and measures. This content was taught in the first year of study. In their second year of study, the content of the first year was extended by including fractions, simple proportion, practice with and comprehension of tradesman's bills (Seroto, 2000). The mathematics curriculum was therefore not promoting critical thinking and problem solving. Teachers' understanding of content, pedagogy and curriculum, which are identified as key pillars to successful mathematics understanding by Shulman (1986), was minimally promoted, there being no mention made of any teacher-development workshops or in-service training. The inferior mathematics education that was offered to teachers then may account for teachers' understanding of mathematics today. The majority of teachers who attended the former Apartheid colleges of education are still in the system, and are mostly found in the foundation phase.

In the United Kingdom, teachers are regarded as experts when it comes to understanding of curriculum content. In this regard, countries bear the responsibility of improving educational practices to ensure acquisition and development of specific subject knowledge (Paulson, 2001). This implies that well-capacitated teachers have expertise in the subject because they have been capacitated and developed to gain that understanding. Hoadley and Jansen (2013) argued that the intended curriculum determines what its developers anticipate should be taught in each subject offered in that particular country. The point here is that what teachers teach is according to the prescription, not according to their own design. A report provides an overview of the key findings of the research conducted in Gauteng and KwaZulu-Natal on the quality of teaching and learning of mathematics and science in schools. The Centre for Development and Enterprise

(2014) acknowledges that, although the quality of the schooling system in South Africa is poor, with poor literacy and numeracy levels; the CAPS content is highly structured. Such is regarded as the strength of this curriculum model.

The South African Mathematics CAPS prescribes the content that teachers must teach from Grade R to Grade 12. This content is divided into five content areas which are numbers, operations and relationships; patterns, functions and algebra; space and shapes; measurement; and data handling. The prescription of content is not unique to South Africa; other countries as indicated below also have structured mathematics content. The content is viewed as structured because it is specific to mathematics and laid out according to the prescripts of the designers. In a case study that was aimed at gaining insights into effective teachers of mathematics in the first and second years of formal schooling, McDonough *et.al.,* (2002) found that there is also basic prescribed content to be taught in schools. Six educators, whose learners showed improved performance in mathematics were sampled to take part in the study. Findings were that content that they were teaching included number, measurement, and space (McDonough and Clarke (2002). These are similar to the South African mathematics CAPS content areas, except that there are no patterns, functions and algebra and data handling. The topics in each strand are also similar to the topics in the CAPS mathematics content areas.

In all Turkish primary schools, teachers also follow the same mathematics curriculum set by the Ministry of National Education (Kılıç, 2013). Instead of content areas, Bulut (2007) and Kılıç (2013) confirm that in Turkey these are called learning areas: there are only four compared with the five in South Africa. These learning areas have been outlined in a handbook of elementary school mathematics curriculum (Board of Education, 2005) as numbers, geometry, measurement, and data. For the learning area numbers, teachers, through teaching, develop learners' ability to use numbers and digits, the ability to estimate and to use the four basic mathematics operations with understanding, identifying connections between the fractions, percentages, and the decimal fractions. Learners are also skilled in identifying patterns; and within these patterns, establishing relationships. Lessons learnt are used to assist learners in problem-solving activities. Over and above this, teachers, as experts, are expected to develop problem-posing activities which are to be incorporated into the learning areas. The curriculum emphasises that this should be a daily routine, in which learners are expected to pose and solve addition problems.

In the elementary French mathematics curriculum, content areas are known as areas of focus which are numbers and arithmetic, geometry, and measurement (Fowler and Poetter, 2004). Similar to Turkey, the main strategy used to teach mathematics is through problem-solving in 13 French primary schools. There is also an expectation that by the end of their elementary years learners should have mastered the prescribed content which includes numbers, decimals, addition, and subtraction and multiplication techniques which are grade appropriate. In Kenya, they have three curriculum strands which are numbers, measurement and geometry (Kenya Institute of Curriculum Development, 2017.

From the above deliberations it should be noted that various terminology has been used for what we call content areas; however, the primary mathematics curriculum is identical worldwide. The first focus is on developing the concept of number, through problem-solving activities. Secondly, learners must understand patterns and algebra. Hobden (2007) developed a primary mathematics learning guide for undergraduate student teachers. In this document Hobden (2007) defines number concept development as "the child's level of understanding of numbers in a particular interval." Mastering of numbers thus develops at levels which are hierarchical in nature. Hobden has identified four levels of number-concept development. Level 1 is counting all objects. Learners at this level of understanding need symbolic objects or representations to be able to perform computations. At Level 2, learners start counting further. They no longer count all the objects or numbers in a sequence. They have the ability to conceptualise a number as an abstract object without relating it to any real-life references. Then learners computing at Level 3 understanding have the ability to replace numbers with two or more numbers that are more convenient to work with; hence the method's involvement of decomposition of numbers. Last comes the Level 4 understanding. At this level, learners require a sophisticated understanding of place value; they should have the ability to conceptualise tens and new units formed from ones. Learners are also able to meaningfully use standard algorithms when computing. The deliberations on levels of number-concept development therefore suggest that teachers also must be able to understand their way of teaching of numbers as stipulated in the clarification notes section for each grade in the CAPS Mathematics Grades 1-3 (DBE, 2011). Furthermore, Hobden (2007) explains that teachers, at all levels of schooling should have an understanding of the mathematical milestones their learners travel towards mathematical proficiency. Teachers must themselves have a good understanding of the key mathematical concepts; teachers should have explored these concepts in depth (The Report of the Expert Panel on Early Math in Ontario, 2013).

Another content area, space and shape, forms part of curriculum content; because understanding and mastering these concepts leads to a deeper understanding of geometry later in the study of mathematics. The measurement outlined by Gifford (2005) is a process of using tools with numbers, and allocating numbers to measures such as length, weight, or speed, so that they can be compared. This, in the CAPS mathematics, incorporates measuring of time, mass, and length, using both non-standard and standard units of measure. The teacher has thus to be grounded in this content. Lastly, there is data handling in which learners collect, interpret, analyse, and represent data.

Using a lens from the South African perspective of foundation phase mathematics, a closer look is focused on how the content is organised in the CAPS. Firstly, in the content area number, operations and relationships, a number of topics and some strategies are outlined that must be used when performing calculations. In the CAPS mathematics document (DBE, 2011), the first five topics are aimed at developing the concept of number. These topics are counting objects: counting forwards and backwards; number symbols and number names; describing, comparing and ordering numbers; and place value. A panel of experts who compiled the report on Ontario's early math reached an agreement that developing number sense and numeration is a foundational strand for primary mathematics. The reason provided by the panel is that number sense pervades the other strands of mathematics; it may be connected with mathematical activities in all strands and with mathematical teaching moments throughout the school day (The Report of the Expert Panel on Early Math in Ontario, 2013). Thus for learners to master all the prescribed content, topics and skills, they should have developed a strong sense of number.

The remaining topics focus mainly on operations and relationships of numbers; and are aimed at equipping learners with calculation skills through problem solving and introducing them to the four basic operations. These topics as specified in the mathematics CAPS (DBE, 2011a) starting with problem-solving techniques, then context free calculations of addition and subtraction; repeated addition leading to multiplication; grouping and sharing leading to fractions; sharing leading to division; money division; mental mathematics; and fractions. The content area patterns, function, and algebra, expose learners to early learning of geometric and number patterns. Then space and shape cover topics: positions, orientation, views, 3-D objects and 2-D shapes, and symmetry. Content area number four, which is measurement, covers the topics of time, length, mass, capacity, perimeter and area. Length and mass start by introducing learners

to both standard and non-standard units of measurement. In the fifth content area, data handling, learners learn how to collect and organise, analyse and represent the data using various representations of data including bar graphs and tallies.

According to Hansen (2017), number concepts are taught in a hierarchical order because they help learners to develop number sense. The Ministry of Education, Singapore (2012), agrees that mathematics is hierarchical. When teaching mathematics, we need to start with the foundational or basic concepts before moving to higher concepts. According to DBE, this is known as progression of content (DBE, 2011); Wood and Hedges call it content coherence. Content is therefore organised to show progression. Teachers must have an understanding of content entailed in each grade of the phase they are teaching, and also in the next phase.

Pietarinen *et al.* (2017) conducted a study with the aim of exploring determinants of curriculum coherence. These researchers further explored the interrelations between implementation strategy, function of reform, and curriculum coherence, as viewed by curriculum designers. In this study Pietarinen *et al.* (2017) report that curriculum content in Finland reflects the didactic tradition. Subjects have been designed to indicate general content per grade, concepts and skills to be developed in an orderly manner. The above-mentioned researchers further argue that coherent curriculum content has a direct positive influence on learners' learning and performance. This conclusion resonates with Khoza's (2015a) findings on mathematics CAPS, that its content distribution is its main strength. Findings from Khoza's study (2015a) indicate that participants are aware of the content they are supposed to teach. Participants further understand and are able to interpret this content. They also highlight the importance of curriculum coherence in that it helps in the development of schools and teachers. Furthermore, assessment is based on the same content that is taught in each grade.

2.4.3. Summative assessment in action

One of the questions that Tyler (1979) suggests curriculum developers should ask during curriculum development is: how can we determine whether the purposes of education are being attained? This, according to Tyler, can be successfully accomplished through assessing the curriculum. Assessment is therefore, according to (Amua-Sekyi, 2016; Taras, 2005), core, and of central importance to education; and integral to teaching and learning in any formal school setting. Two reasons for this position are that, firstly, in an educational setting, teachers and

developers use assessment to evaluate whether teaching and learning has taken place. Secondly, assessment is used to determine whether the curriculum is meeting its aims and objectives.

Notwithstanding that assessment is core to teaching and learning, and that teachers are central to this activity, Taras (2005) and Newton (2007) note that there is no common definition and interpretation of assessment. Taras (2005, p. 467) defines assessment as "a judgement which can be justified according to specific weighted set goals, yielding either comparative or numerical ratings." On the contrary, Amua-Sekyi (2016, p. 1) defines assessment as "all activities that teachers and students undertake to get information that can be used to alter teaching and learning." Taras's (2005) definition generalises assessment as a judgement; and Amua-Sekyi's (2016) definition positions assessment as a remedy. The view of assessment as a remedy aligns with the use of assessment information to alter teaching and learning. Such may suggest that there are problems identified during the teaching and learning process which must be attended to. These contrasting definitions may be problematic, and may confuse teachers or other curriculum users who are not conversant with assessment matters, and do not understand that assessment can be used to improve teaching or to assess learning. When it is used to improve or alter teaching, it is called *assessment for learning* and when it is used as a judgement, it is called *assessment of learning* or summative assessment.

Newton (2007) and Mabuza (2018) justify their position of identifying assessment as judgement when referring to summative assessment. Newton (2007) posits that to identify assessment as summative, this assessment characterises the nature of the assessment judgement on which a learner's knowledge, skills, and understanding are assessed. Mabuza (2018) likens summative assessment, specifically, to a court judgement, arguing that, after gathering all the evidence on what has been taught to learners, a judgement is made on whether they are to be promoted to the next grade. This therefore suggests that to authenticate this position, teachers have to assess their learners by evaluating how much they have learnt of the intended curriculum.

Therefore, one way of evaluating how much learners have learnt at the end of a grade, term, or year, is through conducting or administering a summative assessment or an assessment of learning (Taras, 2005; Earl and Katz, 2006 & Dayal and Lingam, 2015). The term assessment of learning is self-explanatory. Assessment is administered after learning has occurred; this is usually administered at the end of a grade, course, or level, determining what the learner has achieved (Newton, 2007; Mundia, 2012 & Amua-Sekyi (2016). Such can be successfully

achieved when teachers understand why they are conducting summative assessment, which translates to understanding its purpose.

When analysing Tyler's position on reasons for conducting assessments, it may be argued that the purpose of summative assessment is to measure learners' knowledge, understanding, and skills against set objectives. Another overarching purpose of summative assessment is to evaluate systems and the impact of education in countries. Taras (2005) adds that summative assessment should not be seen as a monster, such as society views it, but as central and necessary to all assessments. In this way, summative assessment should be regarded as a stepping stone to learning, not only as a tool for validation. This is achieved by conducting high-stakes tests and national tests and examinations such as the Trends in Mathematics and Science Study (TIMSS) and the Annual National Assessments (ANA), to mention only two. High-stakes assessments are tests designed to measure achievement of students, of teachers and schools. In these instances, learners' understanding of concepts of a subject, the teachers' knowledge of a subject and subject matter are assessed against a set benchmark, because these assessments are standardised. It is noteworthy that summative assessment is also used on high-stakes assessments even though in this instance, it is not used for promotion purposes. It is therefore not a coincidence that summative assessments and high-stakes tests are highly valued. The reason may be that these tests are believed to be of quality and set under stringent and focused processes and procedures − hence their ability to be regarded as determinants of promotion, and whether countries are performing at an international standard.

In any school setting, firstly, a summative assessment or assessment of learning is conducted in alignment with curriculum and lesson objectives and learners' opportunity to learn. Clarke (2001) and Satariano (2015) argue that it is imperative for teachers to make learners aware of the curriculum and lesson objectives and to display them. This exercise will help both the teacher and learners to remain focused and be reminded of what they are supposed to learn in that particular subject or lesson. This has a great influence on how and what teachers teach; and serves as an important source of feedback on the appropriateness of teachers' implementation of curriculum content or subject matter. Dayal and Lingam (2015) conducted a study with the purpose of exploring 70 Fijian teachers' conception of assessment. The study focused on assessment as a component of the curriculum, not any type of assessment in particular. Data on the study was sourced using written reflections. Findings of the study from the reflective activities revealed that teachers' understanding of assessment is based on summative uses of

assessment. The majority of teachers in the study defined assessment as testing what students know or as a means to test learners. This type of understanding depicts assessment as serving a summative purpose. The analysis indicates that about 14% of the teachers who participated in the study also viewed the passing of tests and examinations as an important part of the teaching and learning process. This view is held by Amua-Sekyi (2016) in a review conducted on assessment, student learning, and classroom practice. Amua-Sekyi (2016) maintains that the main aim of assessment is to evaluate and report on whether learning has taken place, therefore assessment is integral to teaching and learning.

Hoadley and Jansen (2013) and Dayal and Lingam (2015) posit that summative assessment is mainly there to obtain a measurement of achievement to be used and to decide whether a certain outcome against this measurement has been achieved. Therefore, according to Dayal and Lingam (2015), assessing learning gives stakeholders in education, i.e., policy makers, parents and learners themselves a clear picture of whether teaching and learning has taken place. Therefore in an expert educational environment, quality teaching and learning is measured by learner performance through summative assessment tasks. Underperformance suggests that learners may not have been properly taught; or teachers do not understand assessment practices, and have not assessed learners according to the summative assessment criteria.

Hence, De Luca and Johnson (2017) caution that to be confident in boosting teachers' understanding of summative assessments and its principles, these teachers, themselves, should be able to actively use assessment strategies. Findings of one of the studies Dayal and Lingam (2017) analysed in their editorial are that teachers need specialised assessment understanding, which includes knowledge and skills. The study maintains that this specialised assessment understanding is not a tailor-made process − it develops over time through ongoing teacher learning and experiences.

Adagale (2015) explains that an ideal teacher as a professional is one who understands which factors are critical to assess learners' learning. This is evidence that the teacher has a strong command of the subject content to be assessed, of written communication, and of assessment techniques. In agreement, Vandeyar & Killen (2007) state that one of the factors that influences teachers' understanding of assessment is the understanding of the subject being taught. This teacher, according to Adigale (2015), is able to translate the learning goals into subject objectives; selecting assessment procedures to reflect the curriculum content designed to achieve those goals and objectives. The teacher further understands that he or she is teaching diverse

learners, and uses a variety of procedures to recognise differences in teaching. It may be argued that this kind of a teacher is an expert in the subject because subject matter knowledge, according to the above authors, is key to conducting summative assessment.

In the South African context, learners in Grade 3 are assessed according to the intended content and criteria as stipulated in the mathematics CAPS foundation phase. The summative assessment criteria are stipulated in several ways in the Mathematics CAPS for Foundation Phase (DBE, 2011). Firstly, the summative assessment tasks are regarded as formal because they are marked and formally recorded. These tasks are used to promote or progress learners to the next grade. According to the DBE (2011), these tasks can be administered to a small group of learners, either in practical, oral, or written form. The main techniques of assessing these learners can be observations by the teacher of tasks in which learners indulge, for example, in counting activities and measuring.

In the foundation phase, instead of calling these assessments tests or examinations, they are known as assessment tasks. These tasks are strategically designed to cover content of the subject using techniques mentioned above. Furthermore, because mathematics itself is a language on its own and has its own terminology (DBE, 2011), the DBE has emphasised that assessments in mathematics should not be language-based. If the learners understand the concept, are able to express it mathematically, and the answer is reasonably correct, the learner should therefore not be penalised for technicalities such as spelling.

In Section 4 of the Foundation Phase CAPS Mathematics, over and above the explanation and deliberations of procedures that must be followed when conducting assessments, there is a programme of assessment, and an exemplar of assessment tasks. This programme of assessment tabulates the number of tasks to be conducted each term per grade. The exemplar assessment tasks provide an example of topics and skills that must be assessed in each content area. Researchers such as Ojuko *et al.* (2013) do not support the notion of providing teachers with common teaching and assessment content, including a number of tasks to be administered in each term. These researchers argue that this idea compromises the quality, value, and the whole purpose of assessment.

Despite its detailed nature, Section 4 of the CAPS of each subject in the National Curriculum Statement Grade R-12 was amended; and implementation started in January 2020. The

amendment of the CAPS Section 4 was informed by concerns raised by teachers, subject specialists, parents, and education stakeholders (DBE, 2019). Amongst other concerns, those directed to summative assessment were that assessment was overloaded and there was no guidance on how teachers should use the cognitive levels. There were no clear demarcations between the teaching time and time for assessment (DBE, 2019).

Reflecting on the concerns mentioned above, the amended Section 4 still has the programme of assessment; however, the total number of tasks has been scaled down to 4, from 10 per year, which is a relief for both teachers and learners. Ironically, in intermediate, senior, and further education and training phases, the use of cognitive levels and how the levels should be distributed in a task have been clearly outlined. However, in the foundation phase document the only mention of cognitive levels is "levels of difficulty within tasks should be identified…" (DBE, 2019, p. 15). Is this sufficient guidance for the Grade 3 teacher whose assessment literacy level is low, who lacks skills and confidence in assessment, who experiences difficulty in exercising her professional judgment over her students' performance? (Black *et.al.*, 2010; Harlen & James, 2005 & Dwyer; 2006).

Furthermore, COVID-19 disrupted the academic year, which led to Term 2 not being assessed: there was no schooling due to the nationwide lockdown. Therefore, when the curriculum was trimmed, assessment was also revised. The National Circular 2 of 2020 was issued to guide teachers on how to quality assure and implement the amended 2020 assessment programme. On one hand, the expertise of teachers was further put under the spotlight because mastery of the subject and the ability to identify fundamental content and skills as stipulated in Circular S3 of 2020 were being tried. De Luca and Johnson (2017) maintain that teachers need specialised assessment understanding to be able to conduct reliable assessments. On the other hand, Harlen (2005) warns against relying too much on teachers' summative judgement, and on giving teachers too much autonomy. The researcher argues that this poses the risk of unreliable and biased teachers' assessments.

Therefore, synthesising the perspectives and literature on summative assessment that was reviewed, a common understanding and position of all the scholars is that, firstly, teachers must be experts in the subject they teach. They must have content knowledge to be able to administer summative assessment. Secondly, during summative assessment, teachers assess what the

learners have learnt. Lastly, such is used to determine whether learners will be promoted to the next grade. These views indicate that, although opponents of summative assessment consider it narrow, unfair, and prescriptive (Dayal and Lingam, 2015), summative assessment is systematic and central to education (Taras, 2005). Summative assessment is not only about judgement; it can also serve as a decision level and an impact level (Newton, 2007). At decision level summative assessment serves the technical aim during selection processes. It can take the form of a course or interview, for example. On the impact level, summative assessment can be used to ensure that learners are motivated at all times, because the grade or marks they obtain may motivate them to work harder to move to the next level. To administer summative assessment, one cannot assess learners on everyday knowledge, because the learning material is content-driven and specialised-knowledge-driven. Therefore, it is imperative for teachers to understand their expert roles in the teaching and assessing of mathematics as a well-structured subject.

2.4.4. Teachers as experts

An expert, according to the Cambridge Advanced Learner's Dictionary (2005), is "a person with a high level of knowledge or skill, a specialist" (p. 435). The Collective Agreement No. 1 of 2008 (Education Labour Relation Council [ELRC], 2008) stipulates that a teacher is someone who has a professional qualification in teaching, is registered with the South African Council of Educators, and has the basic knowledge of the subject they teach, as indicated in their qualification. Furthermore, a teacher should have teaching skills, extra and co-curricular skills, have administrative skills, be able to interact with stakeholders, and have good communication skills. The prerequisites and roles of a teacher may appear generic when outlined; however, one needs a teacher qualification to be a teacher. It should also be noted that being a teacher is one thing, but being an expert teacher is another, although the roles are generalised as teacher roles.

Over time, and when the curriculum undergoes changes, the roles of teachers also change; for example, when Curriculum 2005 was introduced into South Africa, new teacher roles in mathematics were required to enable teachers to implement the subject in line with principles that underpinned the current curriculum (Keiler, 2018; Graven & Westaway, 2019). Gacutan (2020) wrote an article in a research publication of the Department of Education of Bataan aimed at giving insights into how the COVID-19 pandemic impacted education systems; and most importantly, the roles of teachers. The findings were that teachers play an important role in society; nevertheless, their roles have continuously evolved.

In another study, Khoza and Mpungose (2020) additionally emphasise the evolving roles of teachers, focusing on the impact of COVID-19 on these roles. This study was aimed at exploring transformation experiences of academics that led to the embracing of the digitalised curriculum at an HEI in South Africa. The findings were that teachers had to change their mindset and practices in using their everyday mode of delivering the curriculum at a higher-education institution, turning to using digitalised methods of teaching to ensure curriculum delivery. Archana and Rani (2017) concur that teachers play a crucial role in developing the interest of learners in education. Teachers possess a wealth of understanding of the learners they teach and what they teach, including other classroom situations (Wolff, Jarodzka & Boshuizen, 2017). Furthermore, teachers play the role of ensuring that behavioural outcomes and curriculum objectives are promoted in the learners they teach (Wolff *et al*., 2017). It may therefore be asserted that teacher roles can also be influenced or affected by circumstances beyond the control of the systems of education. Again, although changes in roles are embraced, these changes do not exclude that teachers be experts in their subjects and when executing their roles (Graven & Westaway, 2019).

An expert teacher, according to Loughran (2011), is a teacher who is aware of what they are doing and why they are doing it. They also monitor their teaching behaviours to enhance children's learning, bringing out the best in them. Their expertise is shaped mainly by their experiences. In embracing the expert roles they play in educating learners, expert teachers acknowledge that teaching is an educative process; and it cannot just be measured by a list of competencies (Loughran, 2011). Loughran (2011) further argues that it should be recognised that expert teachers have expertise that is unique to them, especially in their subjects. Literature reviewed in Araffin *et al.* (2018) identifies expert teachers as excellent teachers whose roles include their involvement in research, publication of articles and teaching materials and professional development of other teachers. Graven and Westaway (2019) identify an expert teacher as one whose teaching task in their subject is a priority and prescribed by the Ministry of Education. An expert teacher is also a content expert in their subject; contributions to their subject are highly valued as it brings out the best in them.

In South Africa, there are systemic roles prescribed for teachers which are expressed in policy documents. Furthermore, these roles are agreed upon by various stakeholders in education (Graven & Westaway, 2019). Stakeholders involved in agreeing on the teachers' roles include

representatives from the Department of Basic Education, teachers' unions, the South African Council of Educators and non-governmental organisations, to name a few. Hence the documents that stipulate the roles are known as the Collective Agreement (2018) and National Education Policy Act, 1996 (Act No. 27 of 1996).

In the Collective Agreement (2008), it is acknowledged that, in executing their expertise, teachers are interpreters and designers of learning material. Teachers are scholars, researchers, and lifelong learners. They are also assessors and subject specialists. Teachers are able to execute their roles once they are able to interpret and design learning materials. Wallen and Tormey (2019) add that teachers should have teacher agency, which the researchers explain as interaction between the individual and the structural aspect of the school, that includes resources, school culture, and policy mandate. Therefore, the mathematics curriculum is presented to teachers in the form of a document and certain other guidelines, such as those of assessment, to be implemented. Prior to implementation, for example in mathematics, the teacher should be able to interpret the content, make the connection between topics and skills, and understand that topics cannot be taught in isolation. The teacher should also be able to assess the content presented formatively and summatively; and this can happen if teachers understand the principles of assessment that underpin the implemented curriculum.

Although roles are prescribed for teachers, there are two activities that we need to take into consideration. Firstly, Westaway and Graven (2019) posit that no two teachers will execute their roles in the same way; they perform the same role differently. Of note also is that the teacher should be a subject specialist, meaning that the teacher should possess both pedagogical and content knowledge. Teachers should have an understanding of mathematics for teaching and be able to flexibly instil the knowledge into the learners they teach (Aydin *et al.,* 2010). Two teachers may have mathematics content knowledge at the same level; but the delivery of the lessons will differ (Westaway & Graven, 2019). This may be because the methods they use will to some extent be informed by the learners they teach. That is where the flexibility as an expert teacher features, as mentioned by Aydin *et al.* (2010).

Secondly, the way in which teachers express these roles is known as teacher identity (Westaway & Graven, 2019) and beliefs. The findings of the study conducted by Ahorem *et.al.,* (2015) are that, in the school setting, teachers view themselves as sole producers and transmitters of knowledge. The purpose of the study was to determine the precise classroom teachers' beliefs;

and thoughts about the roles of teachers and students. The study found that teachers' beliefs about their roles were in line with conventional teaching and learning approaches. However, in the current foundation phase mathematics CAPS the teacher is regarded as a learning mediator. In mediation of learning, teachers have to ensure that they develop learning programmes that enable learners to make sense of mathematics. This will be evident when learners participate actively in well-planned mathematics lessons. It can be asserted that well-planned mathematics lessons can be those in which the teacher clearly states the objectives of the lesson, concepts to be taught, resources that will be used, and how this lesson will be consolidated, to ensure that learners have grasped what was taught. Roles are therefore impacted by beliefs and identity; and can be compromised when teachers insist on teaching formal procedures without making sense of why they are performing a task. This therefore strips them of their expert roles as teachers.

In their study (Aydin *et al.,* 2010) aimed at examining teacher-educator beliefs about the teacher's role in teaching mathematics, findings were that teachers had different beliefs about the roles teachers play in the teaching and learning environment. Teacher educators believe in teachers' roles are associated with the philosophical underpinning of the new curriculum. Participants identified with roles such as a person who guides learners. Some projected a belief that a teacher is an authoritarian and has authority. Some said that the teacher is a supporter and encourager.

Therefore, being a subject-area specialist becomes crucial because teachers will be grounded in knowledge, skills, values, principles, methods, and procedures relevant to the subject. The teachers' understanding of the subject will be well developed. In the case of mathematics as a school subject, Voskoglou (2019) posits that expert teachers of mathematics should be able to manage mathematics whenever it is needed in their own lives. Furthermore, for the teacher to have a good performance in their subject they need a wide and deep knowledge of the mathematical topics relevant to their teaching. This will be possible if the teacher becomes a researcher, scholar, and lifelong learner. Teachers have therefore continually to develop themselves academically, specifically in their subject.

Of concern is that Voskoglou (2019) noted that primary school teachers, especially in the foundation phase, teach mathematics and many other subjects prescribed in the curriculum, but have not specialised in mathematics. These teachers do not have the mathematical background they should have for teaching mathematics, teaching it nevertheless. This is a similar case to the

South African context because teachers who are teaching foundation phase, during their teacher education training, are not offered mathematics as a major subject. These teachers are taught mathematics education for teachers, which is merely a basic outline of the content on mathematics in the current curriculum, providing some strategies on how to teach each topic or concept. This evidence concurs in a way with Ida's (2017) argument that what matters and makes an expert teacher is the effectiveness of their work. Subject knowledge, level of qualifications, intelligence, competency, and experience do not suffice as labelling a teacher an expert because this does not correspond with learner achievement. In a view held by Ida (2017), a teacher may be well qualified in a subject; nevertheless, the learners continue to underperform in that subject. Therefore, to sustain their expert roles, Araffin *et al.* (2018) maintain that teachers must ensure that they consistently demonstrate high performance**.**

2.5. Conclusion

The chapter started by discussing teachers' understanding as a phenomenon of this study. The chapter focused mainly on the expert understanding of the curriculum as explored by scholars in the field of curriculum, including in the mathematics curriculum. The discussion on expert understanding of mathematics was informed by the current South African Mathematics Curriculum and Assessment Policy Statement (CAPS) in relation to its objectives, specialised content, summative assessment, and expert teacher roles. The next chapter discusses the common understanding and the competence curriculum. This then opens a discussion on learning activities, time, resources, the learning environment, and accessibility.

CHAPTER 3

FOCUSING THE LENS ONTO THE COMMON UNDERSTANDING

3.1. Introduction

The previous chapter provided insights into expert understanding and how expert teachers understand the curriculum, objectives, specialised mathematics content, summative assessment, and expert teachers' roles in the implemented mathematics curriculum. Prior to discussing the expert understanding, the foregoing chapter explained that researchers identified three types of understanding. These were classified as expert (professional/instrumental/vertical/technical), common (societal/relational/horizontal), and individual (personal), as identified by researchers such as Shulman (1986); Skemp (1986); Ernst (1989); Bernstein (1999); Jansen (2004); Schiro (2008); Khoza (2015a); Khoza (2016a & b) under professional and societal understanding. This study classifies understanding as either expert or common understanding. This chapter therefore unpacks teachers' common understanding, the competence curriculum, learner-centred learning activities, learning environment, time allocation, resources, and accessibility**.**

It has been noted that some researchers and scholars (Bernstein, 1999; Skemp, 1976 and Rittle-Johnson & Schneider, 2015) focus mainly on societal (everyday) and professional (expert) understanding. In school mathematics, Beswick (2012) maintains that teachers' understanding may be informed by more than one category of understanding. The researcher further points out that, besides the curriculum, the context and students may also influence the strongest of the teacher's understanding and beliefs. According to Beswick (2012), there is therefore a greater possibility that a teacher with more than one category of understanding that is used consistently to teach in one context may use the other type of understanding in another context. As a result of developing practice, teachers' understanding may change (Beswick, 2012). This implies that a teacher may be teaching at School A, using expert/professional/technical/vertical/instrumental understanding to teach mathematics. After two years, the teacher transfers to School B, whose context is different from School A. A possibility is that the teacher may use common/societal/horizontal/relational understanding to teach mathematics in School B. Teachers must therefore be flexible and adapt to changes in their profession because their

understanding may also be influenced by the learners and their context. The flexibility and the need to adapt to learner needs, contextual factors, and society do not demand that teachers understand the curriculum like experts, but may require common understanding.

3.2. Common Understanding

Implementation of the curriculum from the common understanding perspective occurs when teachers understand implementation of curriculum as informed by the needs and opinions of the wider community they serve (Khoza, 2015a; Ngubane-Mokiwa & Khoza, 2016a). Common understanding in this sense may be positioned as an understanding that everybody else has, even a lay person. However, this type of understanding is not referring to the one outlined in Bloom's taxonomy. In Bloom, understanding is at the most basic level: the 'how to' type of understanding and mostly concerned with procedure. According to Khoza (2016), Bernstein (1999), and Skemp (1976), teachers with everyday understanding of mathematics are informed by what society deems important to teach.

Understanding aligned with this perspective is mostly generated horizontally from simple sources or locally known sources (Khoza, 2016). Bernstein (1999) dubbed this understanding horizontal knowledge. In education, most teachers have access to this type of understanding, manifesting it either orally, using easy to understand language at the level of the majority of people in the society. According to Bernstein (1999) knowledge, behaviour, and expectations are circulated according to status, which Jansen (2004) believes amounts to political benefits for some individuals or structures in the system. Understanding of this nature has limited systematic principles and is segmentally differentiated. Segments do not bear any importance; furthermore, survival of this type of understanding is dependent on social relationship structures (Bernstein, 1999). In this type of understanding conforming to societal affirmation is a norm; and ideas required for understanding a particular topic become basic for understanding many other topics (Skemp, 1976).

Cognisance is afforded to processes, tasks, and activities that become experienced through engagement (Kajander *et.al.,* 2010). Furthermore, understanding is based on what teachers already know about mathematics, not by acceptance of academics on higher-order mathematical properties which teachers may not understand. Skemp (1976), a proponent of relational understanding, postulates that understanding is based on principles with more general

applications by which children are given opportunities to explore on their own and interact with their environment using everyday language. For teachers to successfully implement curriculum, Kajander *et al.* (2010) claim that they only need understanding of 'maths for teaching', not mathematics that mathematicians value. In addition, Venenciano and Dougherty (2007) argue that understanding mathematics should portray what is conceptually important or regarded as a basic in the structure of mathematics; and curriculum should have its foundation in everyday concepts. In this sense, teachers should therefore interact with learners and their environment using everyday language, in which the relational comparisons used can easily be translated to mathematical statements (Dougherty & Venenciano, 2007). This stance resonates with the findings of the study conducted by Brown, Hodson, and Smith (2013); student teachers chose to teach relationally instead of following the curriculum step by step as it is. These students viewed the practice of teaching according to curriculum requirements and guidelines as being put in a closet and acting only in one particular way.

However, even though the students believed in using learner-centred methods of teaching, their practice teaching session did not help much. It was noted that during teaching practice, these students had to follow and align with the actual practice in schools, not what they came with from the institution of higher learning; and this became a challenge for them (Brown, *et al.*, 2013). What these students practised resonates with the findings of Khoza's (2016a) study. The participant, a Bachelor of Education Honours student, used the common understanding of curriculum to inform her teaching, providing reasons for her subject, mathematics, having real-life applications, e.g., measuring mass. The other reason to justify her practice was that society valued mathematics: this would help her learners to break free from poverty in later years as adults. Khoza (2016a, p.115) correctly pointed out that "while she wanted to keep her learners at the centre of her teaching environment, she also wanted ensure that the community is equally impressed by what she is doing, taking into consideration their needs". These practices were not advancing their anticipated practice at school compared with what was offered at their teacher higher-education institutions.

Students teachers' practices and their confidence in implementing the curriculum informed by common understanding in both studies, tempts one to assume that teacher education at higher-education institutions promotes or displays constructivists' approaches to teaching as being more effective and promoting learner participation and involvement. Constructivism's prominent and influential theorists are Dewey, Vygotsky, Bruner, and Piaget, to name a few. Their main focus is on student-centred teaching and learning, and on considering the learner an active agent in the

process of knowledge acquisition (Bada & Olusegun, 2015). This is therefore manifested in the competence curriculum.

3.3. Competence Curriculum

Competence curriculum has been explained by researchers as a curriculum that is underpinned by achieving of outcomes; hence it is called an outcomes-based curriculum. In the outcomes-based curriculum, for example, mathematics in the foundation phase was called numeracy because of its use of the integrated approach. The mathematics learning area included interrelated knowledge and skills which served as foundational competencies that learners had to portray (DoE, 2002). As this curriculum is underpinned by the process/competence approach to curriculum, its main concern is to develop the child as a human being (Kelly, 2009). The curriculum designers are interested in encouraging the learners' natural competencies to be manifested and nurtured (Hoadley and Jansen, 2013). This is because in competence curriculum, strength is drawn from what learners already know, not by what is imposed from the outside. According to Bernstein, in Hoadley and Jansen (2013), in competence/integrated curriculum there is no fixed allocated time for learning programmes, including the teaching of mathematics concepts in numeracy. This, therefore, allows a great deal of flexibility with regard to time allocation for each programme offered at school, which leads to loss of teaching time.

This justifies C2005's unclear pacing of content and time allocated for each concept to be taught. Furthermore, according to Kelly, the competence curriculum takes into account and embraces all the dimensions of education and curriculum which are the curriculum purpose, principles, values, and content. In the competence curriculum, teachers promote aspects of learning that are viewed as acceptable in society, being aligned with societal attitudes, attributes, and competencies of learners. Furthermore, on assessment, Pausigere and Graven (2013) found that assessment in the competence-based curriculum is continuous, portfolio-based, and formative, priority being given to everyday knowledge. Everyday knowledge occurs when teachers understand implementation from societal needs, based on the opinions of society; and horizontal distribution of knowledge (Khoza, 2015a; Ngubane-Mokiwa & Khoza, 2016a). In mathematics, the competence curriculum seems to be problematic as it puts more emphasis on everyday knowledge, ignoring subject-specific content, which not only undermines the special features of the subject, but also the teachers' expert understanding of mathematics as a subject. According to Pausigere and Graven (2013), the enactment of the outcomes-based curriculum during C2005

implementation compromised the teachers' identities. Teachers were unable to position themselves correctly on whether they had expert, common, or individual identities. Equally, teachers who were mathematics specialists and had extensive knowledge of the subject felt disempowered, because specialisation in competence curriculum is not relevant. Learners were regarded as the masters of their own learning; their environment informed their knowledge and understanding of mathematics.

Furthermore, because it was an innovation, teachers had to read and understand what underpinned the curriculum: what they needed to teach, and how they should teach it. Teachers could not have gone about teaching as usual, without engaging with the materials provided to support curriculum enactment. To opponents of the OBE, the seeming extra responsibility for teachers appeared problematic − it needed them to put more time and effort into trying to understand what was required of them. It should be noted that teachers had to change their habits of teaching the same thing they had taught for decades. During the Apartheid era, with the Bantu education, the syllabus never changed. Teachers were teaching the same content, using same strategies for many years; and there was not even a need to refer to the syllabus or the scheme book any more. The Bantu education turned teachers into 'specialists' of the subjects they were teaching.

For this reason, Cross *et al.* (2002) posit that C2005 in South Africa failed because its designers did not have experience related to curriculum development policies. Therefore, Botha (2002) argues that OBE should not be regarded as an unsuccessful curriculum innovation as is fared well in other countries such as Australia, New Zealand, the United States of America and the United Kingdom, to name a few. This suggests that adopting the C2005 as a national curriculum model was not based on poor decision-making.

On the contrary, Bulut (2007), a proponent of the competence curriculum, the purpose of this model of curriculum is to change the focus and content of the curriculum from subject-centred to learner-centred. For South Africa, the challenge was that the country was not prepared and did not have human resource expertise for this innovation. The novice-turned-experienced teachers were then required to understand that teaching and learning is focusing on producing learners who create their own meaning: this is achieved through exposing learners to learning experiences that are learner-centred.

3.4. Learner-centred Teaching and Learning Activities

The success of a curriculum and the meeting of its aims and objectives are dependent on curriculum implementation. Curriculum implementation is underpinned by learning activities; the learner is the main beneficiary of the process. According to Mabuza (2018), teaching and learning activities are lessons that are planned and prepared by the teacher with the purpose of enhancing the knowledge of the learners. Furthermore, according to Mabuza (2018), planning can also be a collaborative initiative between the teacher and the learners. In this instance, however, teachers are encouraged to support learning, and to prepare learners rather than instructing them on what to do and how to do the activities (Hanewickz, Platt and Arendt, 2017). The mathematics activities that learners are exposed to should be meaningful and clearly focused on the mathematics as outlined in the curriculum (DBE, 2011a). Furthermore, the outcome of learning may be predicted if the learning activities are planned. Therefore, without proper planning, learning may not take place.

One can imagine a teacher who understands the aims and objectives of curriculum, the content, and how to assess that particular content going to class with a well-prepared lesson; doing nothing, yet having high expectation that these learners will pass to the next grade at the end of the year. Hence Berkvens *et al.'s* (2014) suggestions that the institution of learning and teachers must expose learners to learning that takes place through interesting learning activities. Learning activities therefore serve as evidence that the teacher has planned and prepared the lesson and the learners are engaging with the content as specified in the curriculum. Learning is taking place; and this learning can later be assessed to ensure that the objectives of the curriculum are met.

For content to become more meaningful learners must experience learning activities in both formal and informal settings or contexts (Berkvens *et al*., 2014). Learning takes place when learners interact with their environment (Schiro, 2008). Khoza (2020) also explored the academics' knowledge of teaching for knowledge building in higher-education institutions, one in the United States of America (USA) and one in the Republic of South Africa (RSA). Data was generated using reflective activities, focus-group discussions, and interviews. The findings of the study are consistent with studies of Berkvens *et al.,* 2014; Schiro (2008) and (Kazima *et al.,* 2016). The studies maintain that, to validate that teaching and learning are taking place, the teachers need knowledge and understanding of the subject content − this will assist them in selecting and using relevant teaching and learning strategies. Therefore the way in which

teachers teach, how children learn, and the types of activities they are exposed to or engage in, are to some extent influenced by the teachers' knowledge of what is entailed as worthy to be taught to learners, and where they learn, which is their environment and context. It is to be noted that the types of activities offered to learners are dependent on what is deemed important in the curriculum. These activities can be either teacher-centred or learner-centred.

Learner-centred activities are those activities in which learners have autonomy to work on their own to solve problems, undertake projects, and collect data on their independently, under the guidance of the teacher. Learner-centredness is said to be influenced by the constructivist approach that focuses on active learning approaches, student responsibility for learning, and social engagement (Corkin *et.al.,* (2019). Therefore to promote this approach, the teacher must create a learner-centred space or classroom for learning. The DBE (2018) concurs that in a learner-centred classroom the focus is on learning. The teacher has the responsibility of designing learning experiences that help learners learn mathematics, using whatever teaching and learning strategies are most suitable for the specific lesson that will be taught.

As much as teachers have to design learner-centred learning experiences for learners, in learner-centred classes, learners do not solely depend on the teacher to provide information. When the stage is set, learners become active participants in their learning. Haylock and Thangata (2007) agree that in the process of learning and teaching in learner-centred environments, it is not about the teacher transmitting knowledge to the learners and them passively receiving it. Learners learn with others, engage with content; build up a shared understanding and share ideas when solving mathematical problems (Haylock & Thangata, 2007, Machaba, 2013, Tanujaya *et.al.*, 2017; & Mabuza, 2018).

For successful learner-centred teaching and learning to take place, Haylock and Thangata (2007) identified five forms of mental activities that promote mathematical understanding. Teachers should familiarise themselves with these mental activities which have a strong foundation in the constructivist approach to teaching and learning. The above researchers opine that, in the process of learning in a learner-centred classroom, learners construct relationships; they reflect on their experiences, articulate what they know, and take possession of mathematical knowledge learnt on their own. This is inclined to the common understanding, which positions and supports learning as an activity that can be undertaken under any context as long as there is teamwork, time to reflect under the guidance of the teacher and showcasing of competence. The learner-

centred activities therefore lead to attainment of skills as per curriculum objectives; these in turn lead to improved learner attainment (Mabuza, 2018).

According to Kim (2001) and Khoza (2017) this, therefore, firstly requires teachers who understand school as a societal cluster; and that teaching and learning can be horizontally distributed (Khoza, 2017). Secondly, teachers also need to understand that what is deemed real cannot be discovered − it is socially invented. Again, that knowledge is created through interactions with one another and the environment. Lastly, learning occurs when individuals engage with one another because learning is a social process.

Curriculum reform that promotes learning requires teachers who are innovative and willing to change. However, it has been noted by (Williams, Cudd *et.al.*, 2020) that it is not an easy task to change teachers' beliefs, practices, and behaviours. Such practices change very slowly. The findings of the study conducted by Williams *et al.* (2020) when observing teachers in their practice showed that the student-centred methods were used during class teaching for only 22% of the time allocated for teaching and learning. The autonomy of teachers is not underrated − they are regarded as masters of their own classroom. Therefore, during teaching and learning, teachers allocated learner-centred activities based on organising learners in their more preferred setting, which is small groups or as individuals. Other findings were that teachers who organised their learners in small groups used most of their teaching time on learner-centred teaching and learning activities. Although learners are autonomous in the learner-centred setting, the teachers still have the responsibility of planning and researching the method and the viability of content to be offered in a learner-centred setting. This is informed by Skemp's (1976) argument that in mathematics, there are some topics that cannot be taught in a learner-centred setting or relationally, as he calls it. These topics need the teacher to take centre stage and teach learners instrumentally.

Skemp (1976) agrees that teachers, even if they are provided with a curriculum that is aimed at relational understanding, find it difficult to restructure their way of teaching to adapt to the changes: they therefore continue with their instrumental ways. This is consistent with the findings of Moru *et al.'s* (2014) study that investigated how teachers viewed the impact of instruction on enhancing their knowledge of teaching. Participants acknowledged that they used mostly the instrumental ways of teaching mathematics; but their practice changed after they enrolled for a BEP 217 course. It was during this course that their mindset on teaching instrumentally shifted towards relational teaching. Similarly, Scott *et.al.*, (2018) found that in

Mexico the curriculum is underpinned by constructivism. However, schools have continued to use the behaviourist ways of teaching. Teachers found it difficult to implement constructivist pedagogies because the system has never been able to abandon a centralized, transmissive, and authoritarian educational administrative and curriculum approach (Moru, *et al.,* 2014).

Tanujaya *et.al.,* (2017) conducted case-study research with the aim of describing the mathematics instruction, challenges, and opportunities in Manokwari Regency in Indonesia. The role of the Indonesian curriculum is to enhance students' thinking abilities in learning mathematics. The curriculum offers guidelines on the teaching of mathematics, which aims to support learners in constructing mathematics in problem-centred interactive activities. Of note, as mentioned earlier, is that, in learner-centred classes, learners do not depend on the educator to prescribe information for them: they are active participants in their learning. Furthermore, these learners value contributions from their peers during the learning process. The teacher's main role is to guide them in instances in which they find it difficult to solve a particular problem.

With the Indonesian curriculum so explicit about promoting learner-centredness, the findings of the study were that teachers nevertheless continued to use teacher-centred teaching and learning activities. Similar practices were found in Williams *et al.'s* (2020) study. Teachers' instructional practices change slowly because it is not an easy task to change teachers' beliefs. It therefore seemed as though the changes in curriculum created a mismatch between the teachers and the requirements of the new curriculum. These findings are consistent with Machaba's (2013) research from a constructivist theory perspective. The aim of the research was to establish the approaches teachers use when teaching mathematics computation. Data that informed the researcher's findings was collected using observations, interviews, and document analysis. The main findings were that teaching and learning were dominated by the teacher; very little interaction with children took place. The teachers used whole-class teaching; during teaching they were not aware that some learners did not understand what was being taught.

In the South African context, the CAPS foundation phase mathematics is silent about learner-centred teaching and learning activities. However, it provides guidelines for teaching mathematics using whole-class activities, small-group teaching and independent activities (DBE, 2011). In the same CAPS document, for Grade R teaching, it is clearly stipulated that there are child-centred activities that learners will be exposed to. The teaching approach in Grade R is an integrated approach, play-based, and promoting holistic development. The Grade R content is still aligned with the competence curriculum; the way children learn is still based on the everyday

understanding of teaching and learning. Therefore learner-centred teaching and learning in the mathematics curriculum for Grade 3 in South Africa has been done away with in line with the OBE. While certain aspects of the OBE were kept, such as the critical outcomes, learner-centred teaching and learning was overlooked: the focus was on performance and covering the content.

Based on the findings of the above studies, there is consensus in literature that curriculum reforms envisage curricula that promote learner-centredness. Teachers can use learner-centred teaching and learning activities in their teaching and learning spaces. However, it is evident that learner-centredness is a far-fetched dream; teachers still find it satisfying to stand in front of learners, teaching them the traditional way. Many teachers blame this practice, teaching instrumentally or traditionally, on the way in which they were taught mathematics (Moru *et al.*, 2014). Skemp (1976), however, opines that it does not help to blame the education system for the challenges; instead, we should focus on the cause, which he identifies as the teachers' inability to use learner-centred approaches or to teach relationally. Possibly, the teaching and learning environment can aid in improving the teachers' use of learner-centred teaching and learning activities.

3.5. The Learning Environment, the Catalyst in Teaching

A learning environment, as it is known and explained by researchers, is a location, an allocated space or a nurturing space in which teaching and learning take place (Head Start ECLKC, 2012; Adnan *et.al.;* 2014; Ibem, *et.al.*, 2017). The learning environment is the one in which teachers, learners, resources and facilities effectively interact; and one cannot function without the other (Adnan *et al.*, 2014 & Mabuza, 2018). Pellegrino (2017) posits that learning environments that are effective are knowledge-centred, learner-centred, assessment-centred, and community-centred. There is a relationship between all components of a learning environment, i.e., the learning environment should be conducive to learning and assessment; it should be accessible by the wider school community, and should expose learners to knowledge. This position is consistent with Bernstein's (1975) theory that in the classroom context, amongst others, there is a relation between subjects, i.e., teacher-learner and learner-learner; between discourses, i.e., interdisciplinary, disciplinary, academic, and non-academic knowledge; and between spaces, i.e., teacher's space, learners' space, and spaces of different learners. However, being an opponent of learner-centredness and regarding it as weak framing because of its horizontal nature, Bernstein (1975) regards the learner-centred learning environment as framed by a weak

classification. There are no boundaries between learners of diverse social groups; which means that all learners share physical spaces and resources. Bernstein (1975) also believes that learner-centred environments produce horizontal knowledge. Teaching is not framed by rich content that produces school knowledge. The researcher's position is therefore aligned with teachers who have a common understanding of educational underpinnings.

Despite Bernstein's classification of a learning environment, Berkvens *et al.* (2014) comments that an environment can be either a formal or an informal setting; what matters is that learners are engaging with that environment, and learning is taking place. These researchers postulate that teaching and learning, unlike being confined to a four-walled classroom, can be moved to any effective environment where learners can engage with materials that they know in real life. A learning environment, therefore, whether formal or informal, is a prerequisite for learning to take place. The main activity is the interaction between the teacher and learners, and the learners and learners in the specified environment. It has been pointed out above that the learning environment is an allocated space for teaching and learning; therefore, it should further be noted that this allocated space can either be a real-life learning environment or an online learning environment.

3.5.1. The physical learning environment

Teaching and learning have over the years to date taken place at a school, in a classroom setting. A school and a classroom may therefore be regarded as environments that both teachers and learners share to advance the curriculum visions. Bernstein refers to the school and classroom as pedagogic social contexts. Bernstein notes that these contexts are defined by power and control relations between spaces, discourses, and subjects. These are pedagogic and social: these are spaces where teaching and learning, traditionally, is assumed to be taking place. Berkvens *et al.* (2014) argue that it is not only the school that can be used for learning; motivating environments also exist outside school. The learning opportunities created there are often more natural than those inside the classroom because learners are easily able to relate to these. Regarding the issues of power, it may be because between the teacher and the learner, the teacher is the responsible other. Therefore, the teacher is the one who has authority on how the classroom, as a learning space, should be organised in terms of the seating arrangement, where and how resources are used, and how learners should behave. In this instance, it may be argued that teachers have power and control over what happens in their classrooms. It is, therefore, the school setting that will determine the successes and failures of education.

Sithole (2017) conducted a mixed-methods approach study aimed at investigating the causes and consequences of the school setting in promoting a positive learning environment. There are further arguments that the learning environment influences learners' behaviour; and that the learning environment can impact learners' performance (Sithole, 2017). To promote learner-centred learning, classrooms or allocated spaces for learning, must be properly managed with relevant resources that embrace such; and must also be well kept inside and out to motivate learners to learn.

There is consensus in literature that conditions of the learning environment are impacted by real-life conditions. The condition of the school buildings can affect learner performance (Ibem *et al.*, 2017; Sithole, 2017 & Mabuza, 2018). In the various studies conducted for various purposes, the above researchers consistently agree that in buildings that are well kept, with furniture that is in good condition, well-ventilated classrooms, there is evidence of improved learner performance and teacher effectiveness. All participants are motivated and feel safe in the learning spaces provided for them. For these reasons, Ndlovu (2017) and Ibem *et al.* (2017) opine that teachers, as managers of their classrooms, have a responsibility to organise the educational setting by providing a conducive and accessible learning environment that facilitates learning and motivates learners to learn mathematics in a variety of ways. Furthermore, the environment should afford learners opportunities to interact, cooperate, and to share opinions with one another (Durmuş, 2016); this therefore promotes learner-centredness.

On the contrary, teachers and learners may easily be demotivated by a learning environment that is unkempt, dilapidated, and overcrowded, amongst other factors. Such will affect teacher and learner motivation and performance (Ibem *et al*., 2017; Sithole, 2017 & Mabuza, 2018). The issues of overcrowding in South African schools and other countries such as Kenya are thorny. This problem is mostly systemic, with political and social bearings beyond the teacher's understanding and capacity. Ndethu *et al.* (2017) conducted a study aimed at teachers' and principals' perspectives related to large classes, in which a questionnaire was used as a data-collection method for 198 secondary-school teachers and 18 principals of the sampled schools. The findings from teachers and principals are that large classes have a negative impact on the teaching and learning of mathematics and languages.

Secondly, teaching in a large class affects the teacher's classroom management because delinquent learners may go about unchecked, continuing to disrupt the teacher and other learners. These findings are consistent with Zenda (2020), that large class sizes affect the implementation

of practical activities and discipline. Furthermore, teaching time may be adversely affected as the teachers have to deal with many learners at once. A large class is referred to as a class that has a learner-teacher ratio of more than 40:1 (Ndethiu *et al.*, 2020). The United Nations Educational, Scientific and Cultural Organization (UNESCO) established that in 2015 the learner-teacher ratio in South African schools was 30.3:1 as of 2015. However, in the Southern and Eastern African Consortium for Monitoring Educational Quality: SACMEQ IV conducted a year earlier it was established that the learner-teacher ratio was at least 40:1.The learner-teacher ratio is the average number of learners that a teacher has in class. In contrast, Ndethiu *et al.* (2020) argue that very overcrowded classrooms are the norm in many developing countries and are often perceived as a threat to educational quality. Similarly, in South African townships, informal settlements, and rural schools, there are often between 50 and 70 learners per class. Common factors that affect these overcrowded schools are poor or lack of infrastructure, lack of teaching resources, and lack of specialised rooms such as libraries and computer rooms (Zenda, 2020).

The lack of or poor infrastructure is highlighted in the SACMEQ IV quality studies conducted between 2012 and 2014 in fifteen southern and eastern African countries to compare learner outcomes and teacher performance in education. Particularly in South Africa, the purpose of administering the SACMEQ study was to enable the Department of Basic Education (DBE) to undertake integrated research and training; and to develop the capacities of educational planners to monitor and evaluate the conditions of schooling and the quality of its education systems against national and international targets (SACMEQ, 2017, p. 3). Regarding infrastructure, the study uncovered that in South Africa, there is improvement of infrastructure across the nine provinces. According, to the report (SACMEQ, 2017, p. 25), the most improved provinces are the Eastern Cape with (48.9%), KwaZulu-Natal (56.6%), Limpopo (46.6%) and Mpumalanga (51.7%). However, despite these improvements, the average Grade 6 learner was in a school where the percentage of learners who experienced the indicated item fell below the national benchmark. Given the demographics of these provinces, most of these schools are in rural areas (SACMEQ, 2017).

These findings are consistent with Mabuza's regarding the location of the school. The location, i.e., urban or rural, is impacted by a number of factors including the school finances and the school community. Children from previously disadvantaged backgrounds are most at risk of educational barriers and failure because many schools in rural areas face shortage of resources. The environment in which children are brought up, and of the school, are constraining teachers

to become innovative and to advance learner-centred approaches to teaching, especially in mathematics, such being a practical subject in the foundation phase. This therefore may become a struggle for teachers in teaching mathematics. In foundation phase mathematics, learners have to manipulate concrete objects and apparatus more often as a foundation for understanding the mathematical concepts.

With all of the above challenges faced by teachers, in 2020 matters were aggravated by the schools' closure worldwide due to the emergence of the COVID-19 pandemic. According to the data held by the World Health Organization, COVID-19 is the disease caused by a new coronavirus known as SARS-COV-2, following a cluster of cases of 'viral pneumonia' in Wuhan, People's Republic of China (WHO, 2020). COVID-19 has over 241 411 389 confirmed cases of infection, with over 4 912 112 confirmed deaths and over 6 545 309 084 vaccine doses administered. On January 30, the World Health Organization declared the outbreak of Coronavirus a public health emergency of international concern. On 11 March 2020 COVID-19 was declared a pandemic (Cucinotta & Vanelli, 2020). When the COVID-19 crisis reached its peak, there was a sudden closure of schools that resulted in rapid national shifts to replace face-to-face teaching with various forms of ICT-based, remote, and distance education (United Nations Educational, Scientific and Cultural Organization [UNESCO], 2021). Both at the peak of the pandemic and in September 2020, online learning was provided in schools and institutions of higher learning as an effective solution for all countries, globally, to protect educational goals by ensuring that learners continue to learn (UNESCO, 2021). At the centre of the unprecedented times of the pandemic and efforts to save the school year, teachers were again at the forefront to ensure that online learning environments were optimally utilised so that learners did not lose the academic year. It was therefore critical for teachers to understand and ensure that the content that they were teaching in the classrooms, giving learners opportunities to learn and explore within their real-life environments should immediately be migrated to the online learning environment.

3.5.2 Online learning environment

According to Mabuza (2018, P. 111), "the term online learning, sometimes called 'distance learning' is a form of instruction with virtual interaction between teacher and the learner in which media such as the internet are used". According to Son & Hu (2014), technology in teaching demands that teachers use such for teaching. This has of recent years being regarded as central for teachers, as it is believed to stimulate learners' interest in developing their understanding of

concepts; and increasing their proficiency in mathematics. Recently, digital technology in education has featured heavily in the teaching and learning environments, even before COVID-19 struck. However, in the current situation, online learning ensures that, irrespective of the challenges that came with the COVID-19 pandemic, learners are in their classrooms, with autonomy to pace their leaning using the time they have, based on their different learning styles. There are a number of familiar online learning environments that were mostly and are still being used both in basic education and higher-education institutions. These are Microsoft Teams, Zoom, Modular Object-Oriented Dynamic Learning Environment (MOODLE), WhatsApp, Google Classroom, Google Meet, Skype, radio and television (TV), to name a few. These platforms allow teachers, learners, parents, and other stakeholders to communicate. Teachers can teach, post resources, set homework, provide pre-recorded videos, conduct live teaching, assess learners and much more (Govender & Khoza, 2017, Khoza & Mpungose, 2017, Mpungose, 2017, Ramadani & Xhaferi, 2020 & Ružić-Baf *et.al.,* 2021).

In various countries such as South Africa, Tanzania, Alabama, Mississippi, and the Netherlands, higher-education institutions and schools adopted the use of online learning management systems (LMS) for teaching (Khoza & Mpungose, 2020; Benbaba & Linder, 2021 & van der Spoel *et.al.,* 2020). LMSs are online or digital learning environments that use online resources and computing devices for teaching and learning (Kalantzis & Cope, 2020). Even before COVID-19, schools and higher-education institutions (HEIs) had introduced online learning environments; however, these were minimally used by teachers. These environments were meant to be used to add additional resources required by learners and students, to provide parents with extra information, post homework, set test dates; and to update learners and parents on curriculum coverage. Most teachers hardly posted subject-matter-related content on these platforms to support their teaching. They did not see the need to use these platforms as they were meeting with learners daily at school. They were able to give information to parents using newsletters, diary entries, and phone calls.

Despite these innovations, Khoza and Mpungose (2020) found that although online learning was regarded as constructivist in nature and promoting learner-centredness; a number of years ago, adoption and utilisation of online learning in some countries, including Africa, was not accepted as useful, there being elements of uncertainty in terms of their reliability. Williams (2021) adds that, for educators, the use of technology has posed challenges and opportunities as well as fears and concerns. For instance, when the Department of Information Technology of the University of Dar es Salaam (UDSM) was launched, online studies in Tanzania were also introduced; that

was about a decade ago. However, it took five years for the university to offer online studies. Besides the teachers not understanding these platforms, lack of trust in terms of their reliability was also an issue.

In 2020, leaders in teaching and learning had no choice but to embrace the digitalised curriculum after years of struggling to promote utilisation of various LMSs (Khoza and Mpungose, 2020). Hence Agarwal *et al.'s* (2021, p.3) argument that the introduction of online education was more a response of countries to pressure and desperation than to a product of a well-planned innovation. There are online learning environments that were designed in earlier years to be digital, to embrace the developments of technology in teaching, whereas the online environments designed to support teaching and learning during Covid-19 were developed without proper planning. Mukute *et al.* (2020) posit that the introduction of virtual learning environments was a government ploy for learners to learn remotely in curbing the spread of COVID-19. Despite the differing views and opinions, the use of online learning environments became a reality that teachers had to live with. Teachers were required to shift to various types of remote teaching, each requiring a different set of skills, pedagogical knowledge, and expertise that they did not possess (Mukute *et al.*, 2020).

In earlier years, Mokiwa-Ngubane and Khoza (2014), and Khoza (2016) conducted studies exploring ways of teaching science, technology, engineering, and mathematics (STEM) subjects online. Researchers argue that online teaching demands that teachers use technology: this requires that teachers have the relevant skills to take advantage of the devices at their disposal. Technological skills are desperately needed as online teaching, although learner-centred in nature, is teacher controlled (Mabuza, 2018). This means that, although learners have the autonomy to navigate the online platforms, they still need teachers' guidance. There are a number of factors that inform teachers' engagement and control over the platform. Firstly, for South Africa, in the foundation phase, the majority of learners are offered mathematics in their mother tongue. Online environments in South Africa and elsewhere are programmed to use English. The teacher must be able to upload and teach lessons using mother tongue; however, the process of opening the platform must be followed step-by-step; and those steps are in English. African languages are not supported on the Microsoft Teams and other online platforms; English is used as a default language on these platforms. This may not be the case in countries such as China, France, and the Netherlands, these being developed countries. Secondly, there are learners from backgrounds in which parents cannot read or write. Even if they can, they do not have a good command of either English or technology. Lastly, the teacher has to ensure that there is

continuous communication, engagement, and support of learners on the platforms. Therefore, teachers' skills and expertise are crucial.

Other researchers that conducted recent studies on the use of technology agree that teachers need skills and experience in using online learning environments as these boost their confidence (Mabuza, 2018; Mukute *et.al.,* 2021). During this era of online teaching without requisite technological skills, teachers could be made redundant even with relevant subject-specific qualifications, expertise in their subjects, and with strong content knowledge; their expertise became redundant as it could not help them in the task of using online teaching and learning environments. Technology skills may be likened to skills of driving a vehicle. No matter how expensive or cost-effective the vehicle, if one cannot drive, this remains a redundant resource. Similarly in teaching, educational leaders have over the years struggled and resisted using LMSs to embrace the digitalised or online learning and teaching systems because they did not have the need (Khoza and Mpungose, 2020). However, Covid-19 forced teachers to transform and to leave their comfort zones.

Khoza and Mpungose (2020) conducted a pragmatic paradigm study that explored transformational experiences of academics at a higher-education institution in South Africa. Data was collected using Zoom observations, semi-structured interviews, and focus groups with participants that were purposively sampled. The findings of the study are that, despite the resistance, many of the participants were left with little or no choice but to adapt to the digitalised curriculum or online teaching and learning systems. For the purpose of this section, the term online teaching and learning will be used. This adaptation was informed by their interest in competence curriculum with values such as collaboration, democracy, diversity, etc. Furthermore, the COVID-19 pandemic migrated teachers from digital immigrants to digital natives. According to Khoza and Mpungose (2020a) and Williams (2020), digital immigrants are people who were socialized in pre-digital ways before digital technology became prevalent. These people resisted using advanced digital technology. Digital natives were born in the digital world; they therefore readily use technologies to support their teaching.

Amid the pressure faced by governments of various countries and the quest to find innovations to protect educational goals, studies continued to be conducted to explore, investigate, critique, and question the viability of adopting online teaching and learning as the best option for ensuring that teaching and learning continue. There is consensus in literature that online teaching and learning form two sides of the coin: both benefits and challenges were brought about by online

learning environments. Whetstone *et.al.,* (2014); Van der Spoel *et al.* (2020); Khoza and Mpungose (2020b); Son and Hu (2020); Benbaba and Lindner (2021) found that online learning environments offered more benefits than challenges to teachers.

Whetstone *et al.* (2014) conducted a study that explored elementary mathematics teachers' perceptions related to implementation of online tutoring programmes. The findings were that teachers found these easy to implement because they were trained; this gave them confidence to use the platforms. Secondly, learners and parents enjoyed and supported teachers in the use of the programme because they were all learning new skills and ways of thinking about mathematics. Khoza and Mpungose (2020b) conducted an interpretive case study, a different focus, which explored student teachers' reflections on the use of Zoom VCT for e-learning at a South African university. The findings of the study were that students enjoyed the discussions during online teaching and learning. Consistent with these findings, are Benbaba and Lindner's (2021) findings on the study that examined teachers' perceptions of the LMS online teaching of English to non-speakers of the language. The findings are that teachers found the online environment useful because they could easily navigate the platforms when exploring other useful features. Furthermore, it was easy for teachers to access teaching resources, download information, and collaborate with others, because the environment was user-friendly, and supported how they delivered lessons. In another study by Van der Spoel *et al.* (2020), the findings were that teachers who have basic IT skills experienced online teaching positively. These findings suggest that not all teachers had a negative experience of online learning. Also, those who had training in ICT understood and stepped up to the task without demur. Furthermore, online platforms provide many useful resources that benefit teachers, learners, and parents. This encourages collaboration and teamwork for teachers and their colleagues, both within and outside of their organisation, teachers and learners, and teachers and parents.

On the contrary, Son and Hu (2014); Mukute *et al.* (2020); Khoza and Mpungose (2020); van der Spoel *et al.* (2014) and Alexander (2022) found some gaps in the use of online learning environments. Online teaching and learning have been available for over a decade, yet hidden because online teaching, although it was a growing reality, was widely ignored by teachers; efforts to make it work had proved futile. The identified gaps are not limited to, but include lack of training for teachers, lack of resources, poor attitude, time constraints, increased workload, and lack of support. One of the most challenging aspects of implementing online teaching and utilising resources maximally was that teachers were not trained. Based on experience as a teacher, on the issue of training, although institutions of higher education offered ICT courses in

education, teachers opted to study other programmes such as school management, education policy, curriculum studies, even branching out to other fields of study outside the education sector. When the department offers short courses that are aimed at improving teachers' skills in teaching and understanding of content, many teachers opted for assessor, moderator, facilitator and mentoring courses, bluntly ignoring ICT courses offered. For this reason, teachers find it very difficult now to create learning environments that are technologically savvy (Son & Hu, 2014). Mass training must therefore be provided, not only for teachers, but also for learners.

In spite of lack of training, teachers had to tag along and adapt, making mistakes, reflecting on them and improving. The elephant in the room was lack of resources. Khoza and Mpungose (2020) and Mukute *et al.* (2020) argued that the majority of learners taught per these online environments are from compromised socio-economic backgrounds, including rural areas where there is poor internet access, no access to computers, laptops, or smartphones. There is also lack of finances to buy data, no access to radio or TV; and frequent power outages add to the frustrations. In agreement, Chang *et al.* (2021) confirm that children from impoverished socio-economic backgrounds and ethnic minorities are most at risk of educational barriers and failure. Household data at their disposal show that sub-Saharan Africa and, to a lesser extent, Northern Africa lack sufficient devices and internet connectivity to sustain online and other remote forms of teaching and learning for all students. In sub-Saharan Africa, the great majority of students have no access to computers and internet, while some 4-5 of every 10 students in Northern Africa also lacked access.

In India, Alexander (2020) wrote an article that reflected on online education during the trying times of COVID-19 focusing on the experiences of online teaching in a higher-educational institution. The findings were that, during online teaching and learning, there were a number of aspects that hampered the process. The main concern was that teaching time was lost due to lecturers having limited access to students. Lesson goals were inadequately achieved due to lack of or non-participation by students. Most of the students, according to Alexander (2020), reserved their opinions, and decided to be quiet during lectures. Another challenge was that the classes were larger than usual for an online learning platform. There were also challenges of poor internet connectivity which inhibited students' participation during classes. For all these reasons, Alexander (2022) concluded that, until the world returns to safer times, the realities of continuous utilisation of MS Teams' black windows and pixelated images streamed through cyberspace will continue to be our everyday realities. Furthermore, the only time the teacher will hear students' voices will be through asynchronous assignments and collaborative writing exercises.

It is, therefore, acknowledged that there were challenges due to the issues raised above; however, the situation is rather saddening when viewing both the HEIs and the basic education sectors. Unlike in the HEIs, in basic education, teachers and learners were not provided with resources such as laptops and data bundles to access the online learning environments. This led to teachers believing that they were being offered minimal technological support from the Department of Education, also scant support from other teachers and from parents (Son & Hu, 2014). Hence Khoza and Mpungose (2020) and Mukute *et al.* (2020) argue that pedagogical continuity favours the digitally literate with physical and financial access to online learning. For this reason, the digital divide must be addressed. Such will be achieved through proper training of teachers and learners, redeveloping e-learning policies, and provision of e-learning resources Khoza and Mpungose (2020).

The digital divide mentioned above led to teachers being perceived as having a negative attitude towards these innovations. Teachers found it difficult to adapt. They viewed utilising online platforms as a difficult task: they were unable to create learning environments that were technologically savvy. One teacher in Mukute *et al.'s* (2020) study questioned and did not understand why teaching was now supposed to be confined to online platforms. She believed that it was better to teach about COVID-19, not the curriculum. The idea of being forced to rethink and reshape their practices must have also come with many burdens; teachers also having to use time effectively. However, even when used to spending 5-6 hours with learners in the classroom, teachers indicated that utilisation of time on the online learning environment was daunting (van der Spoel *et al.,* 2020). Teachers believe that their workload has increased since they started using online teaching and learning environments. Teachers argue that mediating difficult concepts online was difficult and time-consuming. Teachers have to upload activities and video demonstrations, then later explain them (Mukute *et al.,* 2020 & van der Spoel *et al.,* 2020). This view is mostly upheld by teachers who are aligned with the professional understanding of the curriculum, believing that they should teach, and learners should learn. On the contrary, online learning environments support everyday understanding which is aligned with the competence curriculum and learner-centred approaches. These environments enable teachers to conduct assessment for learning/formative assessment/of children's learning.

3.6. Assessment for Learning

Taras (2005) and Amua-Sekyi's (2016) study as outlined in the previous chapter provided two broad definitions of assessment. Taras definition suggests that assessment is a judgement; and Amua-Sekyi suggests that it is a remedy. When assessment is regarded as a judgement, on one hand, it evaluates what learners have learnt, what have they mastered, and whether or not they will be promoted to the next grade (Taras, 2005; Earl and Katz, 2006 & Dayal and Lingam, 2015). All content that has been taught, with an assumption that learners have learnt, is summed up, evaluated according to a particular criterion, and a judgement made whether or not the criterion has been met. A decision is then taken whether the learner progresses to the next grade, passes that particular subject, or not. Hence this is known as summative assessment. On the other hand, assessment has, until recently in the South African foundation phase classes, been viewed as a remedy. Assessment is a remedy in that, when learners are taught, they are continuously assessed using various assessment techniques and tools to establish areas of need and improvement. This is called formative assessment or assessment for learning. One may even call it action-based assessment because it happens in real-time, it happens on the go, and is reflective in nature. In this section of the study, for consistency, the term assessment for learning will be used.

Assessment for learning is self-explanatory because it illuminates assessment as a means for learning. Without this kind of assessment, it may be concluded that learning may not be taking place. Khoza (2015) maintains that assessment for learning is part of the learning process; it takes place during teaching and learning. Furthermore, the researcher argues that assessment for learning is aligned with learner-centred approaches and is about assessing learning outcomes. This is a view supported by Nortvedt *et.al.*, (2016) that assessment for learning works well for teachers who have a competence-orientated view of mathematics. Mabuza (2018) adds that assessment for learning's use of a learner-centred approach enables the needs of each student to be catered for individually. Such makes it an effective way of supporting learners even when teachers have limited resources (Nortvedt *et al.*, 2016).

Other researchers (Ojugo *et al.*, 2013; Anderson & Palm, 2018; Rummanova *et al.*, 2020) sharing the same sentiments add that assessment for learning is a process of gathering and analysing learners' information on learning, providing them with instructional feedback. If gaps have been identified, the teacher presents plans to improve her practice and learning. Galane (2016, p. 57) agrees that "assessment for learning is an integral part of mathematics curriculum implementation. This provides teachers with the opportunity to reflect on their teaching, and to

modify or improve their practice". Areas of improvement may include pedagogy, resources used, time spent on concepts, and mathematical language used during mathematics lesson. Nortvedt *et al.* (2016) argue that for teachers to successfully administer assessment for learning, they need to change their beliefs about assessments and mathematics. Assessments for learning work well for teachers who have a competence-oriented view of mathematics. Irrespective of the context for which it is used, assessment for learning should improve practice. It is therefore required that teachers understand formative assessment in mathematics as a process that is mainly focused on teachers' knowledge of using a number of strategies for teaching mathematics. This will assist them to develop learners' competencies and skills in learning mathematics.

There is consensus in literature that besides being part of a learning process and for gathering learners' information to improve pedagogy, when effectively used, assessment for learning is also regarded as a tried and tested strategy for improving learner performance (William, 1999; Harlen and James, 2005, Ojuko *et al.,* 2013, Rummanova *et al.,* 2020).

Assessment for learning may also be used as a diagnostic tool by education departments at any level to assess where learners and teachers have to start (Nortvedt *et al.,* 2016). Therefore, besides assessing learner and teachers to improve quality, Boesen *et.al.,* (2016) posit that national assessments have always had an important role in communicating educational goals. An example in the South African context is the Department of Basic Education, since the outbreak of COVID-19, ensuring that at the beginning of the year and in each term they send diagnostic assessments to schools. The purpose of these diagnostic assessments is to assess learners' level of competence of content from their previous grade or term showing readiness to progress to the next grade or more complex content. The results of these diagnostic assessments therefore inform what the teacher must focus on when teaching. This intervention aims to close the content gaps of the previous year or term.

One other formative assessment that was conducted nationally was the Annual National Assessments, which ceased to exist in 2014. The purpose of ANAs was to assess the system's performance in curriculum (DBE, 2015). The other assessment is the Early Learning National Assessment (ELNA) for Grade 1 learners. According to the DBE (2021), the purpose of ELNA is to assess the level of Grade 1 learners' readiness when entering the formal schooling system. The ELNAs are currently piloted and administered in selected schools. These assessments were formative in nature because they were used to assess how much learners have learnt in the general education and training (GET) band. The results were analysed and a diagnostic report was

compiled per subject to identify what was not achieved, offering strategies to improve on identified challenges. The only challenge with the ANAs was that feedback was not given to learners, but to teachers as implementers, to improve their practice. However, there is a difference between when it is used as a diagnostic tool and when it is used for learning. When assessment is used as a diagnostic tool, it is the Department of Education, at any level, that conducts the diagnostic analysis. Teachers will then receive a diagnostic report from the Department of Education. These reports are sent to schools months after the ANAs have been administered. For teachers to successfully use assessment of learning as a learning or diagnostic tool, they need to analyse the assessment on their own and identify concepts that learners could not break through; then plan to re-teach them.

Similar assessments are administered in countries such as the United Kingdom and Australia. Contrary to how the national assessments are used in South Africa, in the UK they are not used as a diagnostic tool but as an accountability measure. Moss *et.al.*, (2021) explain that when children start the reception year (RY) in the UK, they are tested, then tested again when they finish the Key Stage 2 (KS2). KS2 is for learners between the ages of 7 and 11. These tests serve three purposes that are assumed to be key to whole-system improvement. Firstly, the test is to ensure that schools account for learner performance and progress made since they started formal schooling in RY. Secondly, after being tested, test results are used to provide parents with a detailed report of their children's performance. Lastly, these tests are used as a standard for comparing schools and also for monitoring learner performance nationally and internationally.

Despite how the purpose of formative assessment is viewed by a number of researchers above, Cheong (2017) noted that the definitions for formative assessment are narrow − they limit what it is because it is regarded only as assessment for learning and improving practice. Cheong (2017) argues that formative assessment does not regard the guidance provided to the teachers to improve teaching as assessment for learning. Teachers therefore need to be provided with guidance to improve their practice of teaching. This can be achieved through teacher-development activities conducted by either national, provincial, or district departments of education, including schools themselves.

Using Cheong's (2017) argument, we may look at formative assessment in such a way that, initially, when the teacher assesses learners to identify or evaluate whether learning has taken place, what is in store in terms of learner knowledge and skills mastered is unknown. Any gaps discovered must help to evaluate the teaching, applying new strategies that will improve

pedagogy, i.e., the teaching method. By virtue of assessing own teaching skills, the teacher is learning and must improve by researching other tried and tested ways of teaching that have worked for peers.

The teacher may even network with other teachers within the professional learning community to gain assistance and become capacitated. Teachers may also be involved in a lesson study in which a group of teachers work with one another in planning and teaching to improve practice. Mokhele (2017) explains that lesson study is a professional development model for improving teachers' instructional practices. "A professional development programme as a lesson study model should promote learner-centred, knowledge-centred, assessment-centred and community-centred to optimise teacher learning" (Ono & Ferreira, 2010. p. 62). In this teacher-development model, not only learners, but also the teachers and other stakeholders closest to the school are developed. Teachers also benefit more due to its nature on content knowledge and assessment support.

However, Cambridge Assessment (2019) acknowledges that assessment for learning equally values the learners' and teachers' understanding in that from the outset it supports teaching by identifying where the learner is going. The teacher must be transparent about the aims of the lessons and why they need to achieve them. Secondly, when assessment for learning is administered, this identifies where the learner is, i.e., their knowledge of skills. Lastly, assessment for learning focuses on the teacher because he or she now has responsibility to ensure that the learner achieves the end goals. Assessment for learning benefits both the learner and the teacher; it is a collaborative approach which is aligned with the competence approach. In many ways, the teacher will need everyday understanding as there are no specific guidelines on how strategies for teaching must be achieved. Teachers rely on information from everyone who has what might be of assistance.

3.7. Conclusion

This chapter discussed the concepts of curriculum from the common understanding perspective. It started by discussing the competence curriculum, its underpinning, and its implication for the teachers' understanding of enacting the curriculum from the competence point of view. The implication is that teachers need to use learner-centred approaches as they enact the curriculum. When designing activities teachers must ensure that the activities are learner-centred, that they embrace individuality and afford learners the autonomy to work on their own to solve problems,

undertake projects and collect data independently under the guidance of the teacher. Learner-centredness is said to be influenced by the constructivist approach that focuses on active learning approaches, learners' responsibility for their learning, and social engagement (Corkin *et al.,* 2019). These activities are made possible in a learner-centred learning environment created by the teacher; and these environments can either be real-life or online, as discussed.

The chapter lastly discussed the importance of formative assessment as a tool for informing the teachers of where learners are; whether there are gaps, what must be done, and how such must be done. It was also discovered that, as much as there is a wealth of information regarding the need and purpose of formative assessment, literature is surprisingly silent on how teachers must be supported so as also to be part of learning in the formative assessment realm that drives personal identity, leading to the natural identity framework (NIF) (Khoza,2021). The next chapter therefore discusses the NIF in framing teachers' understanding of the implementation of the foundation phase mathematics curriculum. The chapter outlines what is deemed a prerequisite in understanding the implementation of the mathematics curriculum to ensure improved teaching practices, improved learner performance, and assessment practices.

CHAPTER 4

THE NATURAL IDENTITY FRAMEWORK AS A FRAMEWORK FOR TEACHERS' UNDERSTANDING

4.1. Introduction

The previous two chapters of this study discussed literature on teachers' understanding of the implemented mathematics curriculum from both the expert and the common understanding perspectives of the curriculum. This chapter identifies and discusses the theoretical underpinning of teachers' understanding of the curriculum; and for the purpose of this study, the mathematics curriculum in particular. As this is a study exploring teachers' understanding, a framework is vital. Holmes (2012) posits that to explore teachers' understanding, researchers have developed countless mathematics knowledge frameworks. These frameworks provide a vocabulary and a common language through which that knowledge can be discussed. Therefore, the best-suited theoretical framework has all the recognisable aspects of a study under research (Ahmad *et.al.,* 2019). It therefore serves as a pillar that holds the study together, ensuring that it does not fall apart (Grant & Osanloo, 2016).

In grounding the study, Grant and Osanloo (2016) and Ahmad *et.al.,* (2019) maintain that a theoretical framework has to reflect a researcher's assumptions, ethics, and personal beliefs on the topic under discussion. The framework should also serve as a support structure for literature review, research methods, data analysis, and discussion and conclusion of a dissertation or thesis. Furthermore, it guides research by providing a common worldview from which to support the researcher's thinking on how to go about the research. The framework relies on a formal theory which provides philosophy, epistemology, methodology, and an analytical approach to a dissertation.

Over and above the theoretical framework, there are concepts that guide research (Christiansen, *et al.,* 2010), collectively called a conceptual framework. A conceptual framework can be viewed as an instrument for organizing enquiry. A conceptual framework creates a compelling theory-based and data-driven argument for the importance of the problem, the rigour of the method, and the implications for further development of theory; and for the enhancement of practice (Kumar & Antonenko, 2014). Therefore, a researcher's understanding of how the research problem will best be explored proves a logical structure of connected concepts in displaying the interrelationship of the ideas in the study, and the theoretical framework (Grant & Osanloo, 2016,

Upadhyay, 2018). This study therefore adopts Khoza's (2021a) natural identity framework (NIF). The chapter starts by providing a brief background to the framework. The professional and societal identities and concepts that underpin them to produce teachers' understanding are thereafter discussed and critiqued in detail. Lastly, the individual understanding is presented. This is the stabiliser of both the professional and societal understandings, which will then usher in the natural understanding of the Grade 3 mathematics CAPS implementation.

4.2. NATURAL IDENTITY FRAMEWORK IN ACTION TO DEVELOP THE NATURAL UNDERSTANDING IDENTITY FRAMEWORK

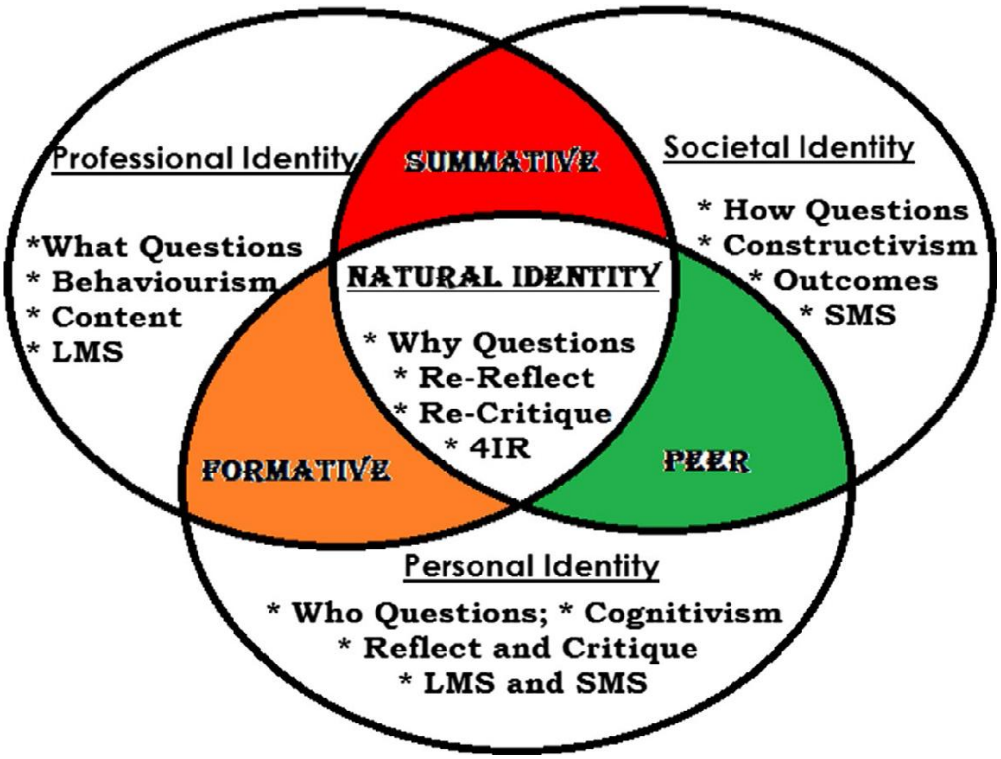


Figure 4.1: Natural Identity Framework: Adapted from Khoza (2021a, p. 4)

4.2.1 Background of the Natural Identity Framework

This study is on teachers' understanding of the implemented mathematics curriculum in Grade 3. It may therefore be justified that their understanding should be underpinned by how they identify themselves in the space of curriculum implementation. This position is what researchers call teacher identity. According to Atwe *et.al.*, (2017), teacher identities emanate either from a traditional perspective or from a post-modern perspective, which at times, ironically,

encompasses equity in education. From a traditional perspective, teachers are viewed as compelled to cooperate with the visions of policy makers. Teachers must perform according to mandatory policies; whereas from the post-modern perspective, identity is viewed as multiple, contradictory, and fluid, because we live in an intrinsically unequal society. On the issue of identities, Atwe *et al.* (2017) caution that modern-day education systems are concentrated on addressing the issues of equity and quality education. Opponents view such as more colonised and oppressive than liberating to teachers, which are in a way concealing their identities.

Khoza (2020) defines teacher identity as teachers' conscious thoughts that interrogate their subconscious thoughts. These subconscious thoughts drive teachers to know and understand their personal needs. There is consensus in literature (Hanna *et.al,* 2020; Wallen & Tormei, 2020; Khoza, 2021b) that teacher identities are fluid but coherent sets of meanings. These meanings are shared socially, through professional knowledge or personal and cultural values and beliefs in specific environments that influence teachers to acquire new actions. Wallen and Tormei (2020) posit that, without being influenced by the external sources, teachers embrace their own understanding of a particular subject; teachers possess this understanding, and the potential which is embodied in this understanding. Therefore, teachers become more confident in applying their own understanding to engage in the process of teaching in a natural way. This whole process Khoza (2021a) theorised as a person's natural identity, which gave birth to the natural identity framework (NIF).

The natural identity framework suggests that for people to understand their natural identity, they must first understand their professional and social identities. According to Khoza (2021a, p. 16), natural identity "is the unconscious, subconscious and conscious cognitive process of believing that all actions and their outcomes are guided by natural laws, actions or forces". For the natural identity framework, Khoza (2021b, p. 5) identified three identities that are used in his study "to addresses challenges of the Fourth Industrial Revolution (4IR) and the COVID-19 revolution", also known as the Fifth Industrial Revolution (5IR). These identities are the professional, societal, and personal identities. Khoza maintains that, for different identities, teachers have their own way of interpreting what they value as quality. For societal identity, teachers depend on the definition given by the majority of teachers: that their value commitment is on society. On professional identities, quality education is about what the rules of the profession define and demand; and for the personal identities, quality education is what works for the individual person. This means that the individual has first to understand their personal needs and how these must

be addressed; then to reflect and critique thus positioning themselves on what works for them, not for the profession or the society.

This is consistent with what Jansen (2004) described as teacher identities, also identifying the three teacher identities as professional, societal, and personal. As old as the study is, Jansen (2004) clarified that when teachers identify themselves as professionals this speaks to how much they know about the subject they teach and how well they are qualified to teach the subject. On societal identities, teachers find themselves needing to please learners, keeping up with demands from parents, and meeting the pressures from the department. Such suggests that society takes precedence over their decisions and identity as teachers. Teachers' personal identity is reflected when teachers understand and act according to what they view as important for them to teach, based on what they can personally manage, influenced by their knowledge and experiences.

Khoza further advanced these three identities by creating links that connect them. The professional and societal identities are connected by the summative assessment which serves as a criterion to test whether learners have understood what they have been taught before their grading. Secondly, the societal and personal identities are connected by the peer assessment to help teachers individually to understand the various learning communities they engage with. For example, as discussed in Chapter 3, when teachers engage in lesson study, they plan, teach, reflect, and critique the planned lesson for improved practice. The last connection for personal and professional identities is per the formative assessment. This connection enables teachers to establish required steps to improve educational practices, this being conducted before, during, and after the lesson (Khoza, 2021b). With these identities and their connections, the natural identity framework then emerged in the context of this study. How teachers identify themselves in the intended mathematics subject curriculum in Grade 3 determines their level of understanding of the curriculum at implementation level. This may either be at the expert, common, or individual level of understanding, as explicitly articulated in the natural identity framework.

Therefore, the natural identity framework (NIF) (Khoza, 2021) is found a suitable framework for this study, serving as a unit of analysis while offering a platform for unifying the expert, common, and individual understanding of teachers in the context of mathematics curriculum implementation in Grade 3. The need to unify the three types of understanding using the three identities is that in practice, teachers find it difficult to be aligned with one type of understanding. In practice, when one type of understanding does not work, teachers tend to switch to another,

or to incorporate two or all types of understanding for improved outcomes. It is argued in the NIF that for teachers to either adopt a professional or societal identity, they must be influenced by what is dominant in their profession as teachers, or the trends in education at the time, or what society deems important. Identities are not inherent to the teacher; they are fluid and not always easy to adapt to. In some instances, they are imposed by developers or people who have power, to align with the curriculum model of the day. In this instance, teachers' natural identities and understandings are therefore overlooked.

The NIF (Khoza, 2021a) acknowledges that the professional/expert, societal/common, and personal/individual identities do exist in the education landscape. However, the NIF closes the gap by bringing in a critical dimension to the theory that acknowledges and views teachers as natural beings, with their natural ways of doing things. This view of teachers acknowledges that, before teachers are influenced by either the experts, who are professionals, or the commoners, i.e., mostly affected by the society around them, they are natural beings. As natural beings, teachers are governed by natural laws according to how they were created by their Creator. In their quest to find themselves and balance the professional and societal, teachers become reflective. Teachers are thus able to improve their practice through reflection and critique of their practice. Hence this study adopts a critical paradigm, using action research as the research approach of the study. The way teachers implement the curriculum is therefore informed by their natural identities as teachers. Natural identities are not a prescription; however, teachers may be implementing the curriculum from either the expert, common, or a combination of the two identities, which is an individual understanding. However, teachers come to the point where they start to re-reflect and re-critique their own practice. Khoza (2021b) maintains that awareness of their natural identities enables teachers to adapt, irrespective of the circumstances. Teachers may be required to adapt to uncertainties or new innovations. Teachers are able to account for their actions, working with and on them, notwithstanding their source of influence. This can be from the professional or societal understandings or the stabiliser of both, which is the personal understanding. For this study to tap into teachers' needs to cope with uncertainties, adapting to new innovations, the NIF is identified as the most significant. This, given the challenges brought forth by the global pandemic, demanded that teachers, amongst other stakeholders in education, but also as frontline implementers of the curriculum, adapt urgently to the new needs. Teachers' professional identity of the implemented mathematics curriculum was therefore under the limelight when this was least expected.

4.3. Professional Identity and Expert Understanding Addressing the 'WHAT?'

Professional identity of teaching mathematics, for example, is required when the curriculum prescribes which content to teach, how to pace the topics, the objectives of teaching the subject, what needs to be assessed, and the role of the teacher as the expert in this, the content-dominated curriculum. This type of curriculum is referred to as the performance curriculum which Bernstein (1975) argues is of high quality; its content is of high status and promotes school knowledge. Bernstein (1975), Khoza (2016a), and Hoadley and Jansen (2012) maintain that, with the performance curriculum, besides content being of high status and hierarchical, subjects are independent of one another, have their own collection of terminology, and are mostly teacher or content-centred. Furthermore, learners have to master specifically selected content in order to satisfy some external prescribed criteria, e.g., national assessments, promotional assessments, amongst others. This is achieved through the administration of summative assessments. Therefore, questions asked of teachers with professional identities are the 'what' questions (Khoza, 2021a); and answers are aligned with the behaviourist content-driven or teacher-centred pedagogies (Khoza, 2021).

However, there are also teachers who subscribe to the other division of understanding, which is identified by researchers like Shulman (1986); Skemp (1986); Ernst (1989); Bernstein (1999); Jansen (2004); Schiro (2008); Khoza (2015a); Khoza (2016a & b); Khoza and Mpungose (2020) and Khoza (2021a) as horizontal/everyday/social knowledge. This study classifies such as common understanding. In this section it is noted that expert teachers are identified by their understanding of objectives of specialised content, expert teacher roles using summative assessments and allocated teaching time. There must therefore be synergy between how much they know and understand the prescripts of intended curriculum, and their actual understanding as experts in mathematics curriculum implementation at Grade 3 level. Everything starts when the teacher understands what must be achieved as per curriculum prescripts; and also in their actual engagements with learners at the end of their lesson, which are objectives.

4.3.1. Behaviourism

Behaviourism is about application of rules concerned with observable and measurable behaviours. Behaviourist teachers align with the curriculum without questioning whether the content or its quality works for them or their learners. These teachers also do not question the

designer, or what has informed the design model of the curriculum and content to be taught. Under the reliance of curriculum on content and following rules, it is required that teachers simply master the curriculum content, understand its aims and objectives, then implement it according to the way it is structured. Due to this learned behaviour, behaviourism positions teachers as know-alls: they are in control of the learning process and use reinforcers to make learning efficient and effective. Furthermore, as teachers, they have the duty of creating a favourable environment for learners (Nalliah & Idris, 2014; Ng'andu *et.al.,* 2013). Teachers are therefore expected to follow a certain behaviour when taking any action. Change of behaviour is followed by specific structures that are there, which must be followed as they are. Behaviourism, therefore, considers being structured and following specific instructions indicated when applying expert understanding.

Furthermore, one of the most distinguishing factors of behaviourism is its promotion and use of lesson objectives during the teaching process. As intimated in the literature chapter of this study, it is critical to note that learning objectives are essentially behavioural objectives in that they establish expectations for how learners should act at the conclusion of the learning process. Behavioural objectives define the overarching purpose of education and any learning experience; without them, a lesson would be lacking in direction and purpose. Behaviourism is aligned with summative assessment. Behaviourists believe that a learner's correct answer to a question, for example, would be interpreted as a sign of successful learning. The behaviourist would then continue to reward correct responses by assigning marks to indicate that the learner has performed well (Boghossian, 2006).

The NIF maintains that in a performance-based curriculum such as the NCS CAPS, teachers are able to use curriculum, after they have understood issues such as the behavioural objectives, its specialised content, the learning management system (LMS), and summative assessment (Khoza, 2021b). Similarly, in Chapter 2, the issues of expert understanding that were discussed were aims and objectives, specialised content, expert teachers, and summative assessment. Therefore, the relevance of the NIF may not be underrated; these concepts are also discussed and framed at professional identity level.

4.3.2. Specialised content

In structuring the specialised content, the NIF content is representing school knowledge, it being the driver of a professional or performance-based digitalised curriculum (DC). Goodson and Rosa (2018) explain school knowledge as a set of concepts, languages, procedures, and practices which arise within the scope of curricular policy as an active reference mark of professional teacher identities. Such highlights the social purposes of the selection of knowledge established in schools. Similarly, the DC content is internationally standardised and is driven by prescribed specialised content that must be mastered by students to enhance their knowledge. The DC content is downloaded on search engines used for scholarly research (Khoza, 2021b). At the institution where the study was conducted the module contents were uploaded using Moodle. Khoza (2021b) maintains that using Moodle to upload module content during that particular time was seen as a better way of affording students the relevant content to be mastered so as to pass their modules; there was an increased pass rate. The challenge, however, was for students who failed group assignments and projects. It is mentioned that they were not given the opportunity of re-doing those projects, unlike other students who failed modules.

In this study, school knowledge is represented by particular content in the mathematics CAPS document. The CAPS mathematics content is what Bernstein (1987) regards as vertical, it being structured, systematic, hierarchical, and using specified knowledge. As indicated, content is structured in that there is an order of how content areas have been arranged. It is systematic and hierarchical because each content area has topics that follow one another from the simple to the abstract. Specification of content in a curriculum is typical of Tyler's approach to curriculum and Bernstein's classification of vertical knowledge. Therefore, it may be justified that teachers' expertise in mathematics, especially content knowledge, is central to their capacity to use instructional materials wisely. Teachers need such expertise to assess students' progress, and to make sound judgments about presentation, emphasis, and sequencing (Ball *et al.*, 2005).

Despite content being clearly specified and sequenced, findings of studies conducted indicate that there are still some teachers who are unable readily to teach the prescribed content (Schmidt *et al.*, 2017, Khoza, 2021b). On the contrary, in other studies conducted by Khoza (2015a) and Pietarinen *et al.* (2017), the findings were that teachers were able to interpret and implement the mathematics curriculum content as specified. The former statement answers the 'what?' question of content in support of the NIF and aligns it with the relevance of teachers' understanding in this study.

4.3.3. Teaching objectives

According to Khoza (2015a), objectives are created according to the teacher's intentions rather than learners' intentions. Therefore, autonomy of the teacher suggests that objectives are more aligned with performance curriculum. James (1999) motivates that when developing objectives, a subject-specific approach should be employed. In agreement, Galane (2016) in a critical action research aimed at exploring subject advisors' reflections on their supervision of the mathematics curriculum states that teachers must set clear objectives that are achievable, based on the aims of the subject or curriculum. It is noted that the objectives set must be achievable yet aligned with the curriculum; however, this is an ideal in a normal implementation process where there are no disturbances. Firstly, the findings of the study conducted by Khoza (2021a) were that those participants who were teachers, were not able to distinguish between objectives, goals, and outcomes. Then, instability or any situation that leads to disturbances in the implementation process, can adversely affect the achievement of objectives.

The COVID-19 pandemic proved that curriculum objectives are only rigid when the developers have power to manipulate and impose what, how, and when content must be taught in achieving the objectives. Khoza (2021b) noted that during the time of COVID-19, the professionals, who are specialists in their modules, had to reduce the number of objectives; there were many students who did not have access to the Moodle platform as a formal DC to be used. This meant that not only content had to be altered, but also, the summative assessment was affected.

4.3.4. Learning management systems (LMSs)

LMSs are online or digital learning environments that use online resources and computing devices for teaching and learning (Kalantzis & Cope, 2020). Because professional identity relies on behaviourism, the behavioural use of LMSs has been on the rise in both higher-education institutions and schools. During the national lockdown there was no physical contact between teachers and learners in observing the COVID-19 protocols for learning and teaching. Various countries, such as South Africa, adopted the use of online learning management systems (LMSs) for teaching (Khoza & Mpungose, 2020; Benbaba & Linder, 2021 & van der Spoel, Norozi, Schuurink & van Ginkel). LMSs have been adopted for use in schools and HEIs in various countries including South Africa, Tanzania, Alabama, Mississippi, and the Netherlands, to mention a few. Even before COVID-19, schools and higher-education institutions (HEIs) had introduced online learning environments; however, these were minimally used by teachers.

The NIF therefore identified the Modular Object-Oriented Dynamic Learning Environment (Moodle), which has an Australian professional identity, as the prescribed LMS to be used at UKZN where the study was conducted. Moodle has been used at UKZN since about 2016. It should also be noted that LMSs have also gained popularity in other countries as well. For example, at the Open University of Malaysia (OUM), which is the first open and distance learning university with over 100,000 students, My Virtual Learning Environment (MyVLE) was developed. This system was already being used in about 2010 to enable learning to be extended beyond the classroom without barriers of space and time (Ng and Latif, 2011). This online discussion forum was created to support especially their adult students who were enrolled to study mathematics at the university: it was found somewhat challenging for them to use the blended learning pedagogy.

However, even though the use of LMSs was made mandatory, academics and educational leaders have been struggling and resisting using LMSs because they did not see a need then to use them (Khoza & Mpungose, 2020; Khoza 2021b). In this study, Google Classrooms, Microsoft Teams and Zoom Video Conferencing were popularly used LMSs in schools − many of the learners and their parents have access to Microsoft and Google services. Similarly, HEIs supplemented the Moodle LMS with Zoom Video Conferencing technology (ZVCT) and Kultura Video Resource (KVR) (Figure 6). Unlike Moodle, these systems have live video-conferencing activity and video-recording/production resources, respectively. These features assisted academics and teachers to conduct summative assessments for their respective modules and subjects.

Of concern, however, is that the reliability and validity of all the assessment methods and strategies mentioned above may not be validated. When students record themselves or join the Zoom meeting, the lecturer does not know for sure that this is the student presenting, because they cannot see them. Even during Zoom meetings, students are encouraged to switch off their videos so as not to tamper with the network connectivity. Similarly, with learners in schools, teachers cannot ascertain which learners are completing the work for themselves, or are staying at home with someone assisting or doing the work for them. These curriculum activities saw many teachers adopting social identities to adjust to societal norms, promoting social spaces in which the majority of their learners use everyday understanding of systems to function in and around their educational spaces.

4.4. Societal Identity and Common Understanding Addressing the 'How?'

Khoza's (2021b) study was conducted during times when teachers had no option but to use the 4IR technologies in teaching and learning to save the academic year, whether or not conversant with technology. It was noted in this study that teachers who are regarded as digital natives were surviving the 4IR turbulence. These teachers used their societal identities to manoeuvre within the turbulence to rescue the academic year and ensure that learners were learning. Khoza (2021b) maintains that teachers' societal identities are formed by nonlinear or unstructured information from opinions of specific societies, called future content, everyday, or horizontal everyday knowledge, which the current study dubs common understanding. Furthermore, societal identity is a practice that limits students' learning of basic content for each subject that enables them to move to the next phase of their learning. The researcher postulates that societal identity's purpose is to feed the heart, ignoring the mind and body (Khoza, 2021a).

Teachers who use common understanding when teaching conform to societal affirmation. Ideas required for understanding a particular topic are basic to understanding many other topics (Skemp, 1976). Understanding, aligned with this perspective, is mostly generated horizontally from simple sources or locally known sources (Khoza, 2016) which Bernstein (1999) described as horizontal knowledge. In education, most teachers have access to this type of understanding. Teachers manifest such either orally, in a particular context, tacitly, or multi-layered and contradicting across context, but not within these contexts. Cognisance is afforded to processes, tasks, and activities that are experienced through engagement (Kajander *et.al.*, 2010); Cognisance answers the 'how?' questions which are operational in nature (Khoza, 2021). Teachers may be driven by learner-centred pedagogies which are more aligned with constructivism.

4.4.1. Constructivism

Constructivism, like behaviourism, is a learning theory of how people learn, which informs how teachers teach. Constructivism is a learning paradigm that assumes that learning is an active, contextualized, or constructive process. The role of the constructivist teacher is to guide students through problem-solving and enquiry-based learning activities. Here they formulate and test their ideas, draw conclusions and inferences, and pool and convey their knowledge in a collaborative learning environment.

There are a number of constructivist theories; well-known ones are the cognitive, the critical, the radical, and the social (Boghossian, 2006; Shah, 2019). Behind the constructivist theory are great

minds such as those of Piaget, Vygotsky, and Freire. Piaget maintains that the way one arrives at knowledge is equally as, if not more, important than the final result. Vygotsky, on the one hand, argues that human learning, development, and knowledge is all embedded in a particular social and cultural context. In this context people exist and grow and they achieve this through a zone of proximal development (ZPD). Freire, on the other hand, posits that knowledge is not a gift or a possession that some individuals have and others lack. On the contrary, knowledge is attained when people come together to exchange ideas, articulate their problems from their own perspectives, and construct meanings that make sense to them (Shah, 2019).

These accounts suggest that constructivism promotes social structures and activities in which the communities and environments are concerned. Khoza (2021b) maintains that constructivism is about everyday knowledge used by teachers when they push for achievement of outcomes. This suggests common understanding of how teachers are teaching. Teachers focus their activities on how best they can adapt the teaching and learning activities to achieve the outcomes. For these reasons, they push for the notion of learner-centred teaching practices.

It should, however, be noted, as mentioned in Chapter 3, that learner-centredness may not be justified because in reality, during teaching and learning, although the teaching and learning activities are said to be learner-centred, the teacher is in control. The teacher plans and designs the activities, giving them to learners to complete. What is exceptional is that when learners are engaged in these activities, the teacher allows them to use their own problem-solving skills, for lessons learnt from their immediate environment on a particular content, answering using knowledge from society.

In this case there are no rules to be followed, no set criteria or standards. Learners are a reflection of their society's way of doing things; therefore, it may be safer to call these activities society-centred rather than learner-centred. The teacher's role is therefore to ensure the understanding of the learners' prior knowledge, which is predominantly informal, the teacher guiding the activity to address the subject before building on it (Shah, 2019). The NIF indicated the importance of academics and teachers in complying with the requirements of constructivism. Such was in support of the competence-based curriculum, as this will lead to the achieving of learning outcomes.

In this study, for common understanding to achieve the outcomes, which were not discussed in Chapter 3, teachers are interrogating learner-centred teaching and learning activities, the online learning environment and resources used within it, especially the online/digital and formative

assessment. The NIF therefore closes the gap in this study's omission of the learning outcomes as one of the main concepts of societal identity.

4.4.2. Learning outcomes

Kennedy (2007) has identified nine definitions of a learning outcome by various scholars. Synthesising all the definitions, it may be concluded that a learning outcome is a written and detailed statement of who is attending lessons and being taught; and who is going to achieve at the end of that learning experience. Learning outcome, as theorised by Mabuza (2018), firstly identifies content, specifying skills to be acquired as clearly stated. Lastly, these are society centred, and promote societal identities.

In the NIF it is explained that specification of learning outcomes in each of the subjects offered, whether at school or at HEIs, gives an indication of how teaching and learning is taking place; and how teaching and learning operations were expected to manifest (Khoza, 202b). Mabuza (2018) agrees that learning outcomes point to learning processes and strategies. Therefore, to promote achievement of learning outcomes, teachers should follow a competence-based digitalised curriculum.

In the process of using the DC, Khoza (2021b) found that during lockdown when remote learning took centre stage, academics found it somewhat challenging and overwhelming to ensure that students achieved the learning outcomes. Firstly, they had to teach content more than once before actual assessments could take place. Secondly, assessment was conducted in ensuring that students achieved the learning outcomes. Teachers had to teach and re-teach content to ensure students' understanding. Teachers had to give students more than one opportunity of presenting their assessment so that they could achieve the outcomes of the modules. This exercise meant that after each time online markers finished marking the assessments, they had to moderate the assessment tasks for each student. Although this was very taxing for the academics, Khoza (2021b) noted that it was more beneficial for students, as the number of students who achieved the learning outcomes increased.

4.4.3. Social media sites (SMSs)

SMSs have been used over the years for social purposes. In education they are examples of educational technologies used by HEIs as part of the 4IR; furthermore, they are now a vital part

of life (Ng & Latif, 2011; Khoza, 2021b). When UKZN went full scale in using SMSs, lecturers and students already had their WhatsApp and personal Facebook pages. They used these for social purposes such as posting their social lives and other information to share with the wider community, nationally, and internationally (Khoza, 2021b). Their usage for educational purposes gained momentum over the years and most recently during the pandemic.

These SMSs, according to Khoza (2021a & b), are aligned with the competence-based DC due to their ability to conduct educational actions or to achieve learning outcomes at basic or societally acceptable levels that promote societal identities. SMSs therefore gained momentum when they became examples of educational technologies used by HEIs as part of the 4IR, especially during lockdown. However, as they are not certified online learning platforms, teachers and learners were initially sceptical of using them given the controversy over them. Amid the doubts, researchers positively presented the use of the SMS as having the ability to foster learning platforms as easily accessible resources to facilitate the operational processing of repeating lectures and assessment tasks (Aksal *et.al.,* 2013; Khoza, 2021b).

For the NIF, Khoza (2021b) identified Facebook and WhatsApp as most popular SMSs that staff and students at the UKZN were using to share and communicate what they were doing. Khoza (2021b) posits that a major advantage of using these SMSs is that most of the lecturers and students have personal Facebook and WhatsApp accounts initially using for personal purposes. A UKZN Facebook page is also used to access information on activities in the university, e.g., sports, open days, registration information, events, amongst others. Due to easy access to this SMS, academics took advantage of this accessibility to facilitate the learning processes that involved mostly WhatsApp.

In their study aimed at verifying the impact of the use of social networking tools such as Weblog and Facebook on the teaching of mathematics-related subjects, Ng and Latif (2011) found that SMSs for teaching and learning have a number of benefits for students and their lecturers. These SMSs enhance, enrich, and extend traditional distance education paradigms, increasing connectivity and engagement of learners. Again, SMSs increase students' level of commitment to their studies. The SMSs did not lose their societal nature, thus embracing the societal identities of both lecturers/teachers and their students/learners.

Mabuza (2018) has, however, found that, in cases where teachers were willing to use these online platforms, their facilities were not in a condition to accommodate such. Furthermore, the majority of teachers and learners have limited or no access at all to the SMS, let alone being able to use them. To mitigate the lacks and to support this initiative, UKZN acquired data bundles from popular network providers such as Vodacom, MTN, Telkom SA, and Cell C to give to the students to access these platforms and keep up with their academic activities.

To embrace their societal identities using the DC through SMSs, teachers in this study were aware of these SMSs and had long started using them. Some teachers, during lockdown, reinforced their utilisation by creating WhatsApp groups for parents and offered online lessons by recording themselves, then sending voice notes to parents for their children to listen to before undertaking the activities. Schools, especially in townships, rural, and informal settlements in the basic education sector suffered the most due to lack of internet connectivity and resources for both teachers and learners. As pointed out by Khoza (2021b), there were no major challenges in the former Model-C schools as they are well resourced.

It is noted with concern that not all parents had a smartphone to access the WhatsApp platform created by teachers for remote learning. Educators in this study acknowledge and appreciate efforts and initiatives taken by the DBE and partners in education to provide live lesson broadcasts on TV, YouTube, and radio. A major concern for teachers is that many learners could not access any of these platforms. Unlike in the HEIs, the DBE did not provide data for learner and teachers to access these SMSs. Even attempting to use SMSs may have had no direct impact on education for both teachers and learners. This resulted in challenges of assessments when learners returned to schools in the second half of the year. Therefore, teachers' social identities were compromised to some extent. Teachers thus explored their personal identities by using reflection and critiquing the status quo.

4.5. Personal Identity and Individual Understanding

Personal identity is the pillar of teachers' individual understanding of what they are doing and why they are doing it. Personal identity is about what works irrespective of influence by professional or societal actions as prescribed; the method by which (pedagogy) each class is taught will not be exactly the same. Expert understanding aspects of teaching will ensure content aligned with the week that they are in to meet the objectives. The teacher also gives summative

assessment activities recorded formally for progression. In another class despite the same expert practices being used, learners may need more support and may learn better through the use of learner-centred activities. The teacher is then the facilitator of learning, ensuring that she uses formative assessment activities as a remedy for improving teaching, which also alters actual teaching time.

Khoza (2021a), using the NIF, argues that one of the most important resources for personal identity is when the teacher's role is pragmatic in nature. This pragmatic role is therefore used for self-reflection. The dynamics of both classes require a reflective teacher who understands that both her expert and common understanding may yield positive results when combined by starting with setting goals for teaching and learning, research on the subject, and how each learner learns. Furthermore, teachers must understand the learners' backgrounds. Khoza (2021b) argues that teachers' habitual actions (individual/personal) help them to understand themselves and their social responsibilities. Therefore, these personal actions are foundational in helping teachers to choose whether they implement curriculum from common/societal or expert/professional understanding. To achieve this type of understanding, teachers must be reflective and must continually reflect on their practice to complement what this study defines as individual understanding. Khoza (2021a) calls this personal identity. Khoza further postulates that teachers who are aligned with personal identity view quality education as an individual's understanding of how personal needs should be addressed; and they view quality education as the type of education that works for individuals, not a group of people. In teaching, for example, what works for one teacher, may not always work for the other. This is irrespective of the fact that teachers are implementing the same content of the curriculum.

Teachers who have individual understanding of implementing the curriculum are pragmatists who believe that aims of education are fluid. As life is dynamic, so aims of education, according to them, should also be the same. The aim of the pragmatic teacher is to develop the learner holistically. These teachers believe that education should prepare learners for practical life experiences; and their views promote hands-on activities. The teacher is regarded as a guide who provides learners with ample opportunities for natural development of their innate qualities. In this instance, the teacher's personal identity is needed to harmonise the professional and social identities (Khoza, 2021b).

Makumane and Khoza (2020) conducted an interpretive study aimed at exploring three propositions of teachers' reasoning, which are personal, social, and professional reasonings. The researchers generated data using purposeful sampling of twenty participants, per reflective activities and one-on-one interviews. The findings were that attachment of educational goals is hampered by focusing more on professional and societal reasoning and disregarding or overlooking personal reasoning. The researchers maintain that personal reasoning emanates from either the professional or societal, which they interpret as the teacher's individual identity. Furthermore, teachers' ways of understanding their environment inform the way in which they manage their teaching and learning activities.

Teachers must individually understand curriculum implementation: this is significant in igniting the reflective teachers within them. It may be concluded that teachers must reflect regularly to keep up with innovations in their field of teaching. According to Dewey (1933), reflections, for a teacher who has individual understanding of curriculum, empower the individual with problem-solving abilities. Reflections are characterised by scaffolding of experiences and events that should be viewed as an active and deliberate cognitive process. These therefore allow teachers to reflect critically. Teachers driven by critical reflections, teach for individual reasons, with the aim of questioning and addressing certain other challenging issues, bringing about change (Galane, 2016). These teachers are, therefore, empowered to develop sufficient knowledge, skills, values, and attitude to promote quality teaching (Khoza & Biyela, 2020). To promote quality teaching and critical thinking, teachers must understand curriculum goals so that they are able to use their guiding framework for teaching and learning (Khoza & Biyela, 2020 and Makumane & Khoza, 2020).

4.5.1. Cognitivism

Cognitivism is valuable and necessary for understanding how people learn; as this focuses on the inner mental activities, having access to those hidden treasures and mysteries of the human mind (Nalliah & Idris, 2014). Khoza (2021a) adds that cognitivism indicates that teachers use personal cognitive processes unconsciously per digital technologies, designing their own original platforms (e.g., websites/resources) for teaching and/or learning. Thus, Nalliah and Idris's (2014) position that cognitivism activates mental processes such as thinking, memory, knowing, and problem-solving, must be explored. This suggests that teachers' personal identities are illuminated as they are able to think and solve problems. Teachers who align with their personal

identity are pragmatic in nature. For them, quality education is about first understanding how their personal needs should be addressed. Quality education is the type of education that works for the individual person, not society, or a group of people (Khoza, 2021a), therefore, leading to reflection on their practice.

4.5.2. Reflections

There is consensus in literature that reflection is a cognitive process in which people use their experiences and actions, look back, and ask themselves questions as to why and how they have done what they have done, and the solutions they have obtained to make improvements (Dewey, 1933; Kabilan, 2007; Killen, 2007; Khoza, 2021b). According to Kabilan (2007), reflection is a subjective yet structured cognitive process and is deeply rooted in critical thinking. Reflection is connected to external realities; enfolded within the teacher's inner feelings. It is through reflection that teachers have the opportunity of questioning their actions based on the contexts in which they teach, together with all the influences of those actions. Dewey (1933) views reflection as a special form of problem solving, characterised by scaffolding of experiences and events that should be viewed as an active and deliberate cognitive process. Therefore, teachers continually reflect, based on the ever-changing demands and responsibilities of their profession (Killen, 2007). Reflective thinking in teaching arises in problematic situations demanding that teachers think, look back, and take action. Therefore, reflection, according to Moayeri and Rahimiy (2019) equips teachers with a vision to recognize the impact of their beliefs on the pedagogical decisions they make while teaching.

The NIF illuminates the episodes of reflective practices that the academics had to embark on when faced with challenges of having to use the DC curriculum. Initially, before DC was made mandatory, teachers ignored Moodle as a LMS. They believed that Moodle was not user friendly and therefore developed a negative attitude towards it. In their new 'normal' everyday practice teachers had to upload presentations in the form of PowerPoint slides. This became very difficult as teachers were unable to present such. Such led teachers to devise means and come up with new ways to ensure that students were learning. Some of the methods identified were the use of their personal Cloud accounts, Google Drive, and even uploading videos on YouTube for student's easy access to the resources (Khoza, 2021b). This whole process suggests that lecturers had to think about their experience with the use of Moodle, Kultura, and other available LMSs offered by the university to advance their professional identity. After several attempts and failures, teachers had to reflect and critique what they were doing. This led teachers to invent

ways of improving; hence they used other online resources to ensure continuity in offering lectures online.

Similarly in this study, as an action research using the critical paradigm, teachers are reflecting, using a reflective activity, on their understanding of the implemented mathematics curriculum in Grade 3. Teachers are reflecting on their practice of implementing the mathematics curriculum from the content-driven curriculum, advancing professional identity and also the society-driven curriculum, advancing the societal identity. Teachers then evaluate the possibility of combining the two identities by reflecting on what works, critiquing their actions to improve the practice.

4.5.3. Critique

"A critique is a process of interrogating one's experiences in order to distinguish between what is good, and therefore to be encouraged; and what is not good, and therefore to be discouraged" (Khoza, 2021b). It should be noted that what is good for one person, may not be good for the other. Similarly, what is true for one person may not be true for the other. Therefore, these phenomena are related based on personal experiences and preferences, and therefore may not be presented as absolute. The findings of Khoza's (2021b) study are that the lecturers used the DC resources such as ZVCT available and accessible to them without critiquing the source. Teachers therefore accepted the ZVCT as the best tool to use for their teaching. However, without critiquing this DC LMS, one cannot conclude that it is the best resource to use. Similarly, in the teaching of mathematics, teachers in this study were torn between what professionals prescribed to be taught using recommended LMSs, and what was accessible to the wider society in the form of SMSs.

In the context of teaching, reflective teachers use their personal identity, which this study calls individual understanding, to interrogate what professionals and society are saying about the successes and failures of the DC innovations, trimmed mathematics curriculum and the adjusted ATPs. Being successfully implemented by a certain number of teachers in a cohort of certain schools from other provinces does not mean that its success is reality. It may be safer to admit that the use of DC and online teaching and learning using various SMSs and LMSs in all the provinces was a success for mostly well-resourced schools with learners that come from stable economic backgrounds. For learners from under-resourced schools and communities that are marginalised with high unemployment and poverty rate, it was a dream to have access even to a

television. Teachers equally faced the same challenge when they teach in those communities. Therefore, the reality of how successful or unsuccessful the DC, trimmed mathematics curriculum and adjusted ATPs were, becomes a reality when teachers start to reflect and critique on how it worked for them and their learners. Over and above being reflective, teachers assumed the role of researchers in their practice as teachers.

4.5.4. Goals

Goals are the outcome of a series of successfully completed objectives, possibly measured over a period of time, which can be daily, weekly, or quarterly (Betti, 2021). When setting goals, teachers should understand that these are set in line with the aims and objectives of the curriculum being implemented (Bergh & Wahlström, 2018 & Anderson, 2020). Bergh and Wahlström (2018) argue that pragmatists strongly believe that humans are always socially and historically situated and are always placed within a situation. For this reason, the setting of subject and lesson goals can be achieved in an actual context, i.e., in a school setting, so as to give the teacher the opportunity of identifying challenges and successes in practice; and being able to reflect accordingly. The crux of the matter may be understood that goals must be achieved, and achieving them is a process.

Researchers argue that goals are not tailor-made for each teacher to achieve: they are aims that teachers have for themselves in relation to their practice. Goals are achieved through a teaching and learning process that teachers embark on (Khoza & Biyela, 2020; Anderson, 2020). Khoza (2016) posits that in teaching, successful teachers start by identifying and understanding their curriculum vision; this will lead them in identifying relevant goals from their subject content. Therefore, for teachers to develop reputable teaching practices and pedagogical development, they should be aware of their own approaches to teaching (Parpala & Postareff, 2021). Teachers must also understand that the mathematics curriculum in the South African context is underpinned by the CAPS mathematics policy, with general aims of the curriculum and objectives of mathematics as a subject. If teachers do not understand the intended curriculum visions, they will not be able to identify and set goals for their subject.

A teacher's goals are largely underpinned by personal orientation towards teaching mathematics. To reach these goals, the teacher will use various resources which include material, intellectual, and contextual resources. Goals are more personal: although teachers are presented with same curriculum tools, their interpretation may be different, and this may impact the aims of

curriculum as intended. Makumane and Khoza (2020) further argue that teachers should be driven by personal understanding as this will empower them to develop sufficient knowledge, skills, values, and attitudes for teaching. This is consistent with White's (2018) position that for teachers to make informed choices about goals they need to achieve, they have to be autonomous. Autonomy, therefore, needs teachers to have knowledge and understanding at an individual level, backed by support. In an article that provided an overview of the eight effective mathematics teaching practices by Smith *et.al.,* (2018), one participant teacher, 'Richard', set goals to focus his decision-making during the lesson that he was teaching on division of fractions. He set the goals for students' learning, which means the goals were not set for what learners would be able to do, but for what the teacher wanted them to learn. Therefore, achieving the goal is the product of the learners' participation in the lesson, which translates to their understanding of the concept taught.

To promote quality teaching and critical thinking, teachers must understand curriculum goals as intended. This will enable them to use their guiding framework for teaching and learning (Khoza & Biyela, 2020; Makumane & Khoza, 2020). When teachers develop goals to be achieved in their teaching, Betti (2020) advises that these goals should address more general, societal, community, or institutional concerns. Society or the broader community which the subject serves fundamentally determines the goals to be manifested in the subject. It is through goals that a teacher realises his or her personality, strengths, and weaknesses in developing teaching styles. This leads teachers to understand their personal identities (Khoza, 2020; Betti, 2020). Teachers' goals are to be achieved through a learning process when they individually engage with what they need to achieve (Khoza & Biyela, 2020). For teachers to understand their personal identity, they must reflect on their practice. This statement is consistent with Van Manen's (1977) observation that teachers who hold dear their personal identity when teaching are more concerned with the value of their goals, connections between principles and practice, and the assumptions that underlie their practice.

Furthermore, goals enable teachers to be reflective and to analyse and critique what works for them in the classroom, how it works, and why it does or does not work. Teachers engage in self-reflective activities to improve their practice, hence this study's utilisation of reflective activities. Galane (2016) posits that the significance of using reflective activities is that they help teachers to analyse, understand, and gain meaning of a particular situation. In this study, the teachers' understanding is of the implemented mathematics curriculum in Grade 3.

4.5.5. Teacher as researcher

For teachers, being a researcher in their practice is having the ability to understand what is valued and taught in school and why is it being taught. Furthermore, as curriculum implementers, teachers who assume their roles as researchers strive to balance issues of a performance and/or competence-based curriculum (Khoza, 2021b). Teachers who research their practice do not always accept the status quo, but as mentioned in the previous section, they interrogate why they have to teach in a particular way. Teachers who critique the existence of what is deemed official knowledge start to work differently based on their personal identity. Therefore, a teacher who assumes a researcher role will achieve ongoing personal, academic, and professional growth through pursuing reflective study in their subject and the teaching profession as a whole, including related fields. This is consistent with the statement of Aliakbari and Faraji (2011) that, when playing a critically reflective role, teachers must engage in deep self-reflection on their position and the effects of their authority in the classroom. This will help them to produce an environment that promotes justice for their learners regardless of all challenges and opportunities they face on a daily basis in their practice as teachers.

Guerrero-Hernández and Fernández-Ugalde (2020) conducted a qualitative study aimed at examining how collaborative research–practice partnership between schools and universities in Chile fosters teachers' role as researchers. Thematic analysis of data was collected using questionnaires and focus groups. The aim of playing researcher roles in this study and elsewhere is to change, improve, and enrich teaching practices. However, findings reveal that teachers found playing their roles as researchers not smooth sailing. Challenges such as time constraints were found dominating the research. There were two dimensions showing how teachers saw themselves as researchers. On the one hand, there were participants who viewed their researcher role as the one who is liberating, relating it to the practical knowledge dimension in their classrooms, leading to improvement of pedagogy and strengthening how they plan and teach. On the other hand, the findings were that teachers viewed their roles as only in relation to their corresponding research objectives, instead of in relation to larger purposes that exceed their school settings. Teachers in this category believed that they were doing too much without the guidance and support of the university staff with whom they have collaborated.

These findings are consistent with Khoza's (2021b) findings that there are academics at UKZN who have assumed roles of either facilitator or instructor. On the one hand, facilitators followed societal understanding, guided by the views of people using the competence-based curriculum

and SMSs. On the other hand, instructors followed expert understanding of the DC curriculum and strictly followed rules by continuing to use the LMSs prescribed by the university, without deviation.

4.5.6. Blended learning

Blended learning is the use of technology outside of the actual teaching time to complement face-to-face teaching. Such combines the societal and professional identities to produce the personal identity (Dockerty, 2020; Khoza, 2021b). Therefore, the blended learning environment combines the face-to-face and online learning environments. Mabuza (2018) agrees that the blended learning environment has its pillars as certified reflections of researched and approved methodologies, borrowing from both traditional and online environments. Rasheed *et.al.,* (2020) and Mabuza (2018) concur that successful curriculum implementation should provide a blended learning environment. This is regarded as the most effective and most popular mode of instruction adopted by educational institutions. The blended learning environment promotes self-directed learning and effectively provides flexible, timely, and continuous learning. This statement suggests that the blended learning environment is the best and most well-known option for educational institutions to successfully deliver lessons, ensuring that teaching and learning takes place.

In reality, this is an ideal; and may work in affluent schools and also in higher-education institutions where students are more independent and have access to devices for support. However, in basic education, some learners are dependent on their parents and care givers to provide them with resources for accessing online learning environments to complement those that are face to face. This is a challenge; the impact of the blended learning environment may not be measured due to lack of access to resources.

Therefore, the success of using blended learning may not be confirmed as it renders itself a barrier to teaching and learning in the context of this study. Firstly, some teachers have devices such as laptops, cellphones, and access to the internet; however their learners either do not have these at all, or have limited access. Other teachers have a cellphone as the only digital gadget in their possession. Where both teachers and learners have access to an online learning environment, another challenging factor is the issue of the language of learning and teaching (LoLT). The online platforms are programmed to be operated using the medium of English. Five of the six teachers in this study teach in schools in which the LoLT of the school is an African

language. The only time they use English is when they teach English as a first additional language according to curriculum prescripts. Therefore, mathematics as a subject is taught in the mother tongue of the learners: in South Africa mother-tongue instruction in the foundation phase has been endorsed as the LoLT.

In the quest to make teaching and learning meaningful, teachers have exhausted the professional, societal, and their personal identities; for some it worked, but for others, it did not work and they failed. When teachers find themselves in this quandary, having tried and failed in everything, the NI comes to the fore. Through failure to produce positive results, no matter how hard they have tried, teachers begin to acknowledge the natural forces that have been enhancing their actions during the COVID-19 revolution. These actions are clearly and newly driven by nature (Khoza, 2021b).

4.6. Natural Understanding Identity Framework

Although the curriculum has been evolving over time and teacher autonomy fluctuating from the teacher being the transmitter of knowledge to being a facilitator of learning, teaching practices have remained the same. Teachers are practising what they naturally understand a teacher to be and what a teacher is supposed to do. In this study, despite how teachers are viewed, teachers understand teaching as being given the responsibility to educate learners, who come to school with little or no knowledge, as best as they can. However, in a study that was aimed at exploring and understanding the migration to a DC at UKZN through the use of digital resources, Khoza (2021b) found that, apart from teachers aligning themselves with either the professional, societal, or personal identities of understanding the curriculum, others were found to be combining the three identities to produce a natural identity.

Natural identity is "the unconscious, subconscious, and conscious cognitive process of believing that all actions and their outcomes are guided by natural laws, actions, or forces" (Khoza, 2021b, p. 17). These natural laws, in teaching, according to Khoza, imply that even if we wish to repeat what we have taught in the same situation and context, it will not be possible because the action, which is the teaching methodology, becomes unique through the natural laws or forces. An example provided is that a teacher can have two groups of learners for mathematics, for example, Grade 3a and Grade 3b. In an ideal teaching and learning situation, the teacher may be teaching them the same content, exerting the same effort for all learners with the aim of all passing and

achieving at level 7 which is 70% to 100%. However, because these learners are not naturally made identically and have varying cognitive abilities, they will not all achieve at the same level.

Similarly, all teachers are presented with the same curriculum to teach; teachers must achieve its objectives as envisaged by the curriculum developers. Nevertheless, in 2020, teachers had to re-reflect on their roles, on what and why they taught in a certain way when DC was introduced. This led the teachers to critique their experiences and practice on both performance and competence curriculum. This type of understanding of the role of a teacher is natural, which Khoza (2021a) calls natural identity (NI). "The NI, as the centre of personal, societal, and professional identities, is driven by self-re-reflection, and re-critique of human experiences that respond to novelty or uncertainty" (Khoza, 2021a, p. 17). Therefore teachers, with all the qualifications and expertise they had in the teaching of their subjects, the support from fellow teachers and district subject specialists, and the teaching experience they had, still found themselves wanting in terms of what they thought they had mastered. They had to re-reflect and scrutinise their understanding to fill the gap of challenges brought forth by the DC. Secondly, teachers had to re-critique what they thought they knew all along, being experts and experienced teachers; until the pandemic hit the world and exposed what they had been ignoring all along, which is the use of technology in their teaching.

Teachers had to adapt to the digital world − it was demanded that they use available digital technologies to ensure that teaching and learning took place. Khoza (2021b) correctly points out that no one was prepared for this huge change, especially not the teachers. To keep up with demands of saving the school year teachers were forced to learn on their own to use digital technologies. They did not undergo any formal training or have workshops to help them do this. The Departments of Basic Education and Higher Education and Training in South Africa and elsewhere helped to ensure that teaching and learning took place; these institutions mandated schools and teachers to use any online platforms at their disposal.

Although some teachers were able to navigate through, many teachers struggled to teach using online platforms. The digital natives were mostly able to navigate through those platforms. The difficulty of using online platforms was identified by researchers who conducted recent studies on the use of technology. It was found that teachers need skills and experience in using online learning environments, such skills boosting their confidence (Mabuza, 2018; Mukute *et.al.*, 2020; Benbaba, 2021). However, this was an ideal for government, whereas it was not practical

in actual learning settings. Due to the hurdles and lack of resources, in his study, Khoza (2021b) found that most of the teachers and learners had to naturally use their SMS knowledge/experience to understand Moodle and other online platforms for e-teaching and learning. This implies that their natural abilities were mostly at play when navigating the online platforms. This was not dependent on what they had studied (professional), collaborative efforts and assisting each other (common) or their experiences and beliefs (individual) on how the online teaching and learning works best. The pressure teachers were under brought about this situation. The implications of teachers' re-reflection and critiquing in this study using the pragmatic paradigm are therefore that teachers had the opportunity to answer the research questions according to their understanding of the implemented mathematics curriculum.

For some teachers, as the chapter discussed, neither the expert (professional), common (societal) nor individual (personal) understanding/identities worked. Hence Khoza's (2021b) observation that when humans have done their best but achieve negative results, they believe that nature is responsible for enhancing or driving actions in the universe. Therefore, their natural identity comes to play; and this is when they start re-reflecting and re-critiquing their practice. Therefore, for the implementation of mathematics in Grade 3, the natural identity framework is found suitable as the framework for this study. Teachers will have the opportunity of not only reflecting and critiquing, but also re-reflecting and re-critiquing their practice. It is acknowledged that the gap found in this framework may result from not many studies having been conducted, using this framework as a framework for analysis. Therefore, using a pragmatic paradigm action research will put the theory to the test, validating its relevance to the current research on teachers' underst

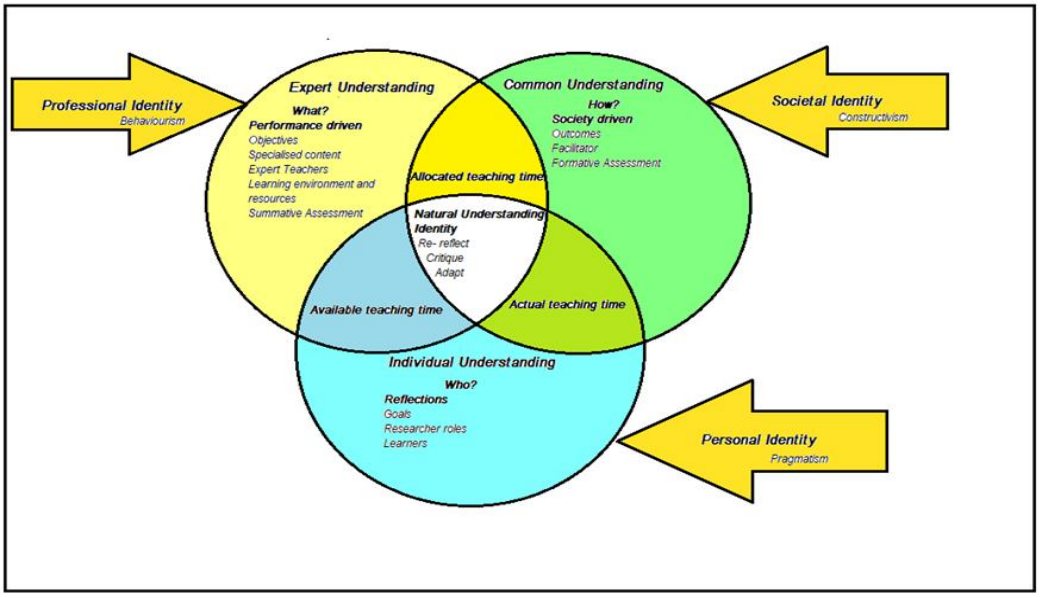


Figure 4.2: Natural understanding identity framework (NUIF) (Adapted from Khoza, 2021b)

The natural understanding identity framework draws its strength from the teachers' understanding as a phenomenon of this study, and from the themes of the natural identity framework (Khoza, 2021b). It is also important to note that the original NIF applies summative assessment, peer assessment and formative assessment as the connecter for each identity. This study has allocated teaching time, actual teaching time, and available teaching time as connecters. In the context of the mathematics curriculum, in a school setting, each subject is allocated only a certain amount of time. Teachers echoed the challenges around the allocated time when teaching mathematics.

Teachers with an expert understanding identity adhere to the allocated teaching time when planning their lessons, including assessments. Teachers using common understanding identities, apply flexible teaching time. They do not follow the rigid time allocated for mathematics, but teach as per the needs of learners. For example, time allocated for teaching mathematics is approximately 1 hour and 30 minutes per day. However, it was observed during the teaching of lessons that none of the participants taught for that long. The longest lesson was about 50 minutes. Those who assume an individual understanding identity, utilise time that is available to teach mathematics, instead of adhering to the allocated teaching time as per mathematics CAPS.

4.6.1. Allocated teaching time

"Allocated time is the total amount of time available for learning, including the length of the school day and a class period. It is the 'opportunity to learn'" (National Education Evaluation & Development Unit (NEEDU), 2018, p. 2). Mabuza (2018) postulates that allocated time for teaching has an influence on selection of learning activities and teaching methodologies to be used in a particular subject. When time is prescribed, it guides teachers on when to teach particular concepts and also to plan in advance how they will teach particular concepts. In the study conducted by OECD (2010) on mathematics teaching and learning in the programme for international student assessment (PISA), findings were that prescription of time by authorities is important. Such helps in regulating overall time allocation for the school year, term, week, day or even per subject. As the study was comparing countries, it was also found that there is a lack of uniformity in how much allocated teaching time is used by different countries. Average time allocation per day is between 3 and 6 hours, which suggests that South Africa is also on a par, there being 7 hours allocated to Grade 3 daily to make up the 25 hours of teaching and learning time in a week. Some countries like Japan have about 36 hours of teaching time per week, while others, for instance Scotland, have 22.5 hours allocated per week.

In Section 1 of each subject's CAPS document, time allocation is tabulated for each phase. Furthermore, it is indicated how much time is allocated for each subject in that particular phase. In the foundation phase, time allocated for teaching in Grade 3, per week is 25 hours. Of the 25 hours, 7 hours is allocated to the teaching of mathematics. Ironically, in the Mathematics CAPS document, on the table for time allocation there is no time allocated for mathematics. Also, the paragraph succeeding the table outlines the way in which content is allocated per subject per grade in the foundation phase; however, it is also silent about mathematics time allocation. The only time in the Mathematics CAPS documents that time allocation is mentioned and indicated is in the clarification notes introduction, where it is explained that "…the duration of time allocated per topic in lessons given in 1 hour and 24 minutes" (DBE, 2011, p. 92) and also on the sides of all the clarification notes from pages 93 to 484 (DBE, 2011a).

Table 4.3: Time Allocation Table for Mathematics in the Foundation Phase (DBE, 2011a, p. 6)

MATHEMATICS GRADE 1-3

1.4 TIME ALLOCATION

1.4.1 Foundation Phase

(a) The instructional time in the Foundation Phase is as follows:

SUBJECT	GRADE R (HOURS)	GRADES 1-2 (HOURS)	GRADE 3 (HOURS)
Home Language	10	7/8	7/8
First Additional Language			
Mathematics			
Life Skills	**6**	**6**	**7**
• Beginning Knowledge	(1)	(1)	(2)
• Creative Arts	(2)	(2)	(2)
• Physical Education	(2)	(2)	(2)
• Perscnal and Social Well-being	(1)	(1)	(1)
TOTAL	**23**	**23**	**25**

(b) Instructional time for Grades R, 1 and 2 is 23 hours and for Grade 3 is 25 hours.

(c) Ten hours are allocated for languages in Grades R-2 and 11 hours in Grade 3. A maximum of 8 hours and a minimum of 7 hours are allocated for Home Language and a minimum of 2 hours and a maximum of 3 hours for Additional Language in Grades R - 2. In Grade 3 a maximum of 8 hours and a minimum of 7 hours are allocated for Home Language and a minimum of 3 hours and a maximum of 4 hours for First Additional Language.

(d) In Life Skills Beginning Knowledge is allocated 1 hour in Grades R - 2 and 2 hours as indicated by the hours in brackets for Grade 3.

In other CAPS documents, i.e., foundation phase life skills, home languages, first additional languages and other subjects in the phase, CAPS time has been tabulated. However, the paragraph was copied and pasted across the phases and subjects and does not include wording on how mathematics is allocated. For this reason, teachers ultimately use their common and individual understanding of when they teach and for how long. They use their expert understanding of time allocation only when they use district mathematics guidelines.

Teachers are aware of the time allocation; however, it is a challenge for them to understand how the time should be distributed across the five content areas of mathematics when planning for teaching. This may be because in mathematics, instead of providing time allocation for each content area, the DBE has provided weightings for the content area. In Foundation Phase 3, the weightings are as follows:

Table 4.4 : Weighting of Mathematics Content Areas. Adapted from Foundation Phase Mathematics CAPS (DBE, 2011a, p. 10)

WEIGHTING OF CONTENT AREAS			
Content Area	**Grade 1**	**Grade 2**	**Grade 3**
Numbers, Operations and Relationships*	65%	60%	58%
Patterns, Functions and Algebra	10%	10%	10%
Space and Shape (Geometry)	11%	13%	13%
Measurement	9%	12%	14%
Data Handling (Statistics)	5%	5%	5%
	100%	**100%**	**100%**
*In Grade R - 3, it is important that the area of Numbers, Operations and Relationships is the main focus of Mathematics. Learners need to exit the Foundation Phase with a secure number sense and operational fluency. The aim is for learners to be competent and confident with numbers and calculations. For this reason the notional time allocated to Numbers Operations and Relationships has been increased. Most of the work on patterns should focus on number patterns to consolidate learners' number ability further.			

There is also a clause in the Mathematics CAPS document stating that the teaching time for each content area can be determined by calculating the total allocated time for mathematics (DBE, 2011a). Furthermore, in the CAPS there is another statement that "On average three or more Mathematics lessons in each week should focus on Numbers, Operations and Relationships. The remaining time is split among the other content areas" (DBE, 2011a, p.37). The statement is justified because in the early years of schooling the numbers, operations and relationships content area is the most important for developing learners' number concept.

These are the ideal expectations of what should be happening in schools to ensure time on task and to avoid losing time; however, the opposite occurs. There are obstacles and activities that hinder effective utilisation of time. Mabuza (2018) argues that there is no evidence that the time allocated for a subject is adequate to ensure that teachers cover the curriculum content as

stipulated. This may be true in the South African context given the fact that, although mathematics is allocated 7 hours, content areas are not allocated time of teaching, but only the weightings.

Mabuza and Khoza (2018) conducted an action research study that explored the reflections of educators on the instructional time using reflective activities, interviews, observation, and focus groups as data-generation methods. The above researchers posit that time is one of the critical factors that influences academic achievement; when not properly utilised, it is impossible to regain, it being a non-renewable resource (Mabuza & Khoza, 2018). The findings of their study revealed that teaching time, although stipulated in curriculum documents, is lost, as it is in most cases used for other activities such as sports and other subjects regarded as 'important'. This finding is consistent with the findings in the NEEDU (2014 & 2018) reports, that during the allocated teaching time, there are many activities that disrupt the school day.

These activities include sports meetings, teacher training workshops, union meetings, and memorial services, amongst others; all these activities compromise the time on task for teaching and learning. COED (2010), on the one hand, has identified another time-consuming factor as poor classroom management by teachers. Teachers in the study indicated that much time is wasted when learners are disruptive and do not listen to the teacher at the start of a lesson. On the other hand, teachers claim that the allocated teaching time for mathematics is insufficient for covering the whole curriculum, hence some teachers use the available teaching time. This suggests that, whenever there is time available to teach mathematics, they teach it.

4.6.2. Actual teaching time

As was discussed in the previous section, mathematics is allocated 7 hours of teaching time per week. However, teachers who align with societal identities understand that teaching time can be made flexible. This can be possible when teachers integrate concepts across subjects or within a subject, using the actual time they use to teach mathematics per day. These are the characteristics of the competence curriculum. Bernstein (1986) maintains that in competence curriculum there are no fixed time periods. There is much flexibility with regard to time allocation for each programme offered at school.

Firstly, systemic, national and provincial assessments are administered for mathematics and home languages. Therefore, teachers spend more time teaching mathematics, which goes beyond what is allocated. Secondly, COVID-19 changed the NCS Grade R1 12, without following

processes of proper curriculum reform, citing a state of disaster. The actual teaching time became a reality in that it overruled the allocated teaching time. Teachers were forced to teach as and when learners were available. The 7 hours were reduced to three-and-a-half hours due to rotation models. In schools with a high enrolment number, learners were attending schools once a week, which is four days a month. This further reduced the teaching time. Concepts and skills to be taught, as mentioned in the previous chapter, were clustered and taught when learners were available. Teachers had to teach with the time available for the subject and when learners were present at that point. Teachers had to ensure that teaching and learning took place by teaching the core content and skills. They also had to ensure that assessments were administered within the available time.

It is currently known that there have been curriculum content losses over the past 2 years; hence the DBE's development of the three-year recovery annual teaching plans (ATPs) to close the content gap. Although the implementation started in 2021, learners are still on a rotational model. Of note is that the ATPs are designed to accommodate a one-week rotational model. However, in schools with a high enrolment, learners were still attending school one week in a month, instead of two weeks as per recovery plans, aggravating the curriculum losses and actual time for teaching. The impact of the short time teachers had to teach and administer assessments has not yet been researched. Even during observations, none of the participants taught their lesson above the stipulated time from the mathematics CAPS. There is no research at the moment that has measured impact, which poses a gap in this field and must be studied in future. It may therefore be concluded that teachers' common understanding of the flexible teaching time available for them was a challenge. As mentioned earlier, in learner-centred teaching and learning environments, teaching time is flexible and may be manipulated by the teacher to ensure that what needs to be taught is covered. During the time of this study, it was a challenge to be as flexible as possible due to the effects of COVID-19 in education. In this instance, teachers may have needed their individual understanding and personal identities to understand and utilise the actual teaching time. Thus teachers would validate their understanding of the time they took to implement the mathematics curriculum.

4.6.3. Available teaching time

Available time, in the context of this study, may be regarded as time at hand, notwithstanding the allocated time for the subject that the teacher has to utilise to optimally teach mathematics.

Mathematics has been identified as one of the core and compulsory subjects in the foundation phase. Due to the time constraints brought forth by COVID-19, allocated and actual teaching time has been lost. The closure of schools, according to studies, was one of the large-scale pandemic control measures during the COVID-19 pandemic. One of the findings in their study was that weekly rotations were found to be an effective measure to curb the spread of COVID-19 (Brom *et.al.,* 2021).

This loss of time led to curriculum losses also, as everything and everyone was locked down. Schools, institutions of higher learning, businesses, recreational activities and any other activity that may have caused people to gather and have close contact was locked down, as prevention measures were implemented. The only services that were accessible were medical facilities, pharmacies, and retailers that provided essential services such as selling of food and hygiene products.

Time was lost for almost everything, with the education systems also suffering a great blow. Ardington *et.al.,* (2020) wrote a paper that sought to establish short-term learning losses in reading for Grades 2 and 4 learners from under-resourced school contexts. Data was generated from their longitudinal studies conducted in the Eastern Cape, KwaZulu-Natal, and Mpumalanga's no-fee paying schools. Learning losses were also estimated using the Funda Wande coaching intervention that was conducted in the urban and peri-urban districts of the Eastern Cape Province. The findings were that, besides official school closures and the phased-in grade approach to school reopening, school days were further lost due to strategies implemented to ensure adequate social distancing in classrooms, such as platooning or rotational time-tabling which were in line with the COVID-19 protocols. Hoadley (2020) maintains that in the lower grades of schooling, learners lost a third of the total school days in a year. Ardington *et al.* (2020) estimate the time of contact teaching lost to be about 50% to 60% due to school closure and rotational models, maintaining that the current losses have been underestimated. Gustafsson and Deliwe (2020) therefore recommend that the estimated learning losses be inflated by another 25% to mitigate the time lost.

When schools reopened, the Department of Education had already adjusted the curriculum to ensure that core concepts and skills were taught until the end of the year. Hoadley (2020), Gustafsson and Deliwe (2020) and Ardington *et al.* (2020) agree that time was lost; however, the extent of curriculum losses could not be measured, as there is limited evidence to justify such. It

may therefore be argued that the assumptions by the DBE on how much time had been lost were premature. Hence Gustafsson and Deliwe's (2020) argument that it is unclear whether the learning losses identified immediately after learners returned to school, worsened, stayed the same, or shrank over time as the school year progressed. In haste, the time allocation had also to be adjusted. The effected changes in time meant that learners had to come to schools rotationally, coming either on weekly rotation or daily rotation. Hoadley (2020) posits that in schools where learner-classroom ratios were very high, students would have been split into three, attending school only once every three days or one week in three. This was experienced in overcrowded schools such as some in this study − learners had to come to school for less than 10 days a month. It should be noted that these studies were conducted with the main focus on the 2020 and 2021 academic years, including reading in Grade 2 and Grade 4. Therefore, reflective teachers need to use their personal identities and individual understanding to research and evaluate the actual losses incurred. This will be informed by their expert understanding of mathematics, their common understanding and their experiences in teaching mathematics. Teachers will have to utilise the available time maximally to advance improvement in the teaching of mathematics.

This process unfolds over time when teachers engage in reflections on their teaching practice. Also, the reform and innovations in curriculum do have an impact on the fluid nature of teacher roles. The other factor that impacts roles of teachers is the learners they teach and the context in which they teach. These teachers ultimately use their distinctive understanding to navigate the curriculum in such a way that benefits them and the learners. At the same time this is in line with curriculum policy prescripts.

Those teachers who may seem to have a lost identity because neither their professional, societal, nor personal identities have worked for them, assume their natural identity. A natural identity, as Khoza (2021b) mentioned, is noted when people have done their best to align with their former identities, yet have achieved undesired results. These teachers believe that nature is responsible for enhancing or driving actions in the universe. This is for teachers who engage in re-reflections and critiquing their practice when opportunity arises. For them to achieve this, they also need their natural understanding. Hence the study produced the natural understanding identity framework to embrace these teachers' identities.

The challenge that emerged is that, as Khoza (2021b) pointed out, identities, as with understanding, are hierarchical; the natural understanding identity is at the top of this hierarchy. Most teachers are at lower hierarchies because they have been trained formally to be teachers;

they are socialised in societies, and have to adhere to the societal norms so as not to be misfits in their environments. Similarly in this study, it may be concluded that each person's identity comes with many responsibilities whether or not anticipated; and those identities are fluid, hence people need to adapt.

4.7. Conclusion

This chapter, framed by the natural identity framework, discussed teachers' understanding from the professional (expert), societal (common), and personal (individual) identity point of view. Firstly, it showed how expert understandings are framed by professionalism and by adopting a vertical way of understanding the curriculum. Secondly, the chapter discussed the societal understanding influenced by the competence curriculum employing everyday knowledge that is horizontal. The chapter also discussed personal identity, informed by practices of reflections that brought forth the teacher's pragmatic nature of implementing the curriculum. The discussion also acknowledged that the three identities are connected by the summative, peer, and formative assessments respectively, as per the NIF. However it was further discussed that, in this study, these identities are connected by allocated teaching time, actual teaching time, and available teaching time. The choice of time as a connecter for each type of understanding and its implications has also been discussed.

To develop their identities, teachers have to answer the 'what' (professional), 'how' (societal) and 'who' (personal) questions of curriculum implementation which lead to the 'why' (natural identity) questions influenced by their natural abilities of how they achieve their ends. Therefore, to answer the 'what' questions, behaviourism, specialised content, and LMSs as the main drivers which enable teachers to answer were discussed. To answer the 'how' questions, constructivism, outcome, and LMSs were discussed, respectively. Because some teachers were neither aligned with the professional nor societal identities, they used their individual identity to reflect and critique on their own practice. They had to focus on the 'who' questions. Khoza (2021b) framed such as personal identity, with its main principles of a pragmatic DC as cognitivism, reflections, critique, and blended learning (SMS & LMS). The next chapter discusses the research design of this study to align it with the NI framework.

CHAPTER 5

METHODOLOGISING TEACHERS' UNDERSTANDING

5.1. Introduction

The previous chapter explored and discussed the NIF as the key framework that informs the teacher' understanding of the Grade 3 mathematics curriculum implementation framed around teachers' identities. This chapter discusses the mode of enquiry and methodology underpinning this study. This study is a qualitative action research, using the pragmatic paradigm.

This pragmatic study of Grade 3 teachers' understanding of the implemented mathematics curriculum in Mpumalanga Province intends to answer the following research questions:

1. What are the Grade 3 teachers' understandings of the implemented mathematics curriculum?
2. Why do Grade 3 teachers have a particular understanding of the implemented mathematics curriculum?

To answer these two research question, the study started by interrogating literature on teachers' understanding. The research found that a strong determinant of teachers' understanding is the curriculum model that a country has adopted. The two curriculum models that came into play in South Africa are the performance and the competence curriculums. The literature chapter also revealed that, in spite of the curriculum model adopted by a country, teachers' understanding is to a certain extent informed by either the expert, common, or individual understanding of the curriculum.

Therefore, to answer the research questions of this study and to validate the findings on the forthcoming analysis chapter, this chapter on research design and methodology provides a detailed account of how the study will achieve such. A number of studies conducted on research design concur that a research design is a comprehensive logical, flexible plan that guides how research is going to be conducted and serves as a blueprint of that particular research (Ragin, 1994; Terre Blanche *et al.,* 2006; Drew, Hardman and Hosp, 2008; Flick, 2009; Christiansen *et al.,* 2010;). Furthermore, a major determinant of the success of a research design is the types of questions asked. Flick (2009) and Terre Blanche *et al.* (2006); Asenahabi, 2019) add that a research design is influenced by the research questions, methodologies used and resources that are accessible to the researcher; which, all combined provide the researcher with a foundation to

select the type of data required; how the data will be collected (i.e., methods to be used) and analysed; and how the said data will answer the research questions.

For these reasons, Terre Blanche *et al.* (2006) acknowledge that a research design is therefore viewed as a connecter between research questions and the research ensuring that the study maintains its anticipated objectives. Most importantly, research design presents a formal, systematic way of gathering information, being underpinned by structured questions (Terre Blanche *et al.,* 2006). This therefore implies that research design always determines the kinds of analysis which obtain the desired results. This chapter therefore presents the pragmatic research paradigm, research approach, sampling, data-generation methods, trustworthiness/authenticity, data analysis, ethical issues, and study limitations.

5.2. Research Paradigm

Given the literature presented on the research paradigm, it may be agreed that a research paradigm is a comprehensive belief system, world view, or framework that reflects how researchers view and think about the researched phenomenon; the framework guides their actions; informing their meaning or interpretation of research data (Christiansen *et al.,* 2010, Elshafie, 2013; Kivunja & Kuyini, 2017; Creswell & Creswell, 2018; Kekeya, 2019). Researchers' perceptions, interpretation of the world, what is believed to be real and what needs to be known to justify what is real depends on their interpretation of the data collected. Based on the nature of their research, a researcher has the autonomy to choose between the available paradigms.

A paradigm, according to researchers, has four exclusive elements; which are its ontology epistemology, axiology, and methodology (Guba & Lincoln, 1985; Tracy, 2020). Based on the combined conceptualisation of these four elements by researchers (Guba & Lincoln, 1985; Kivunja & Kuyini, 2017; Cohen *et.al.,* 2018; Kaushik & Walsh, 2019; Kekeya, 2019; Tracy, 2020), firstly, ontology refers to the nature of reality and truth that exists and the assumptions we make to believe that our researched phenomenon makes sense or sounds real. These ontological assumptions then give rise to epistemological assumptions. Secondly, epistemology is the nature of knowledge that is grounded in our beliefs and assumptions about knowledge and the nature of the relationship between who knows and who is to know. Epistemological assumptions guide the researcher on which methods of research to use which determines the data-generation tools and data collection. Then, methodology is a shared understanding of the

language of research which includes research participants and strategies for gathering, collecting, and analysing data. Lastly, axiology concerns itself with the values associated with the research at hand. This includes ethical issues and considerations which are the values associated with areas of research and theorizing and what the researchers attribute to the various aspects of their research, the participants, the data, and the audience to which they will report the results of the research. There are popular paradigms that researchers use most frequently to guide their research, which are the positivist, post-positivist, interpretivist, the critical paradigm, and the pragmatic paradigm. Each paradigm has its own underlying beliefs and assumptions (Valsiner, 2000). A brief description of the underlying beliefs and assumptions of each paradigm is provided to ensure how each perceives the world and interprets what is true.

For instance, the positivist paradigm, also called a scientific paradigm, defines a research perspective based on what is known; and uses process of enquiry and a process of experimentation to explore observations and answer questions (Lindsay, 2010; Kivunja & Kuyini, 2017. The research seeks to offer arguments and predictions based on findings. The positivist ontology, experimental methodology, and beneficent axiology are said to constitute the characteristics of an objectivist positivist epistemology (Kivunja & Kuyini, 2017). Post-positivism, on the one hand, provides the worldview for most research conducted on human behaviour typical of educational contexts. Post-positivism challenges the notion of absolute truth, and argues that reality can never be fully comprehended; but at best, only approximately reflects the need to identify and assess the causes that influence outcomes, such as those found in experiments. For this reason, post-positivist researchers use methods that try to strengthen the hypothesis through trying to disprove it. Knowledge developed through a post-positivist lens is founded on careful observation and measurement of the objective reality that exists "out there" in the world. Post-positivists acknowledge that there is a theory. When the research is conducted, the researcher begins with the theory, collects data that either supports or refutes the theory, then makes necessary revisions, and conducts additional tests.

The interpretive paradigm, on the other hand, according to researchers (Christiansen *et al.,* 2010; Silverman, 2013, Galane, 2016; Kivunja & Kuyini, 2017; Creswell & Creswell, 2018), makes an effort to understand and interpret the meaning which people make within their own context; what informs their thinking, which in turn provides answers to what informs their behaviour. The main purpose of the interpretive paradigm is to rely as much as possible on the participants' views of the situation being studied. Participants seek to understand the world in which they live and work. Here meaning is negotiated socially or historically. Due to the strong belief that human

behaviour is influenced by the environment, this paradigm places a major emphasis on knowing the individual and how people interpret their surroundings. When people interact with their environment, its settings, other people, and how they were socialized, they form subjective meanings of their experiences. This, in part, has a greater impact on how people behave. Contrary to the positivist and post-positivist paradigms, the interpretive paradigm places theory after research in order to be based on the information gathered during the act of researching.

The critical paradigm has its origins in critical theory; this paradigm acknowledges that in society there are issues of power and politics (Galane, 2016). Therefore, its main aim is to transform the researched phenomenon and give a voice to both the researcher and participants in their field of study. Hence, Kivunja and Kuyini's (2017, p. 35) position that "the critical paradigm presupposes a dialogic technique, an axiology that respects cultural norms, a transactional epistemology in which the researcher interacts directly with the participants, and an ontology of historical realism". In relation to truth, reality is considered a commutable human action that exists outside the mind, but is historically constructed (Guba & Lincoln, 1994; Shah & Al-Bargi, 2013; Galane, 2016). However, there have been critics of the critical paradigm who claim that critical paradigm research does not provide clear guidelines and frameworks needed to achieve the desired outcomes; the critical paradigm is always advancing a political agenda to justify its existence (Ernest 1994; Elshafie 2013). Lastly, there is the pragmatic paradigm which has been identified as the most suitable for this study because its aim is to position itself towards solving practical problems in the real world (Kaushik & Walsh, 2019).

5.2.1. Philosophical foundation of teachers' understanding: pragmatic research paradigm

The pragmatic paradigm has its foundations in pragmatism, the Greek word meaning action (Kaushik & Walsh, 2019). The origins of pragmatism date back to the late-nineteenth or the early-twentieth century in the United States of America [USA], first seen in the work of philosophers Charles Pierce, William James, and John Dewey (Kaushik & Walsh, 2019). It is noted that the main purpose of pragmatism is to reconcile both objectivism and subjectivism, facts and values, accurate and rigorous knowledge, and various contextualised experiences (Saunders *et al.*, 2019). Therefore, pragmatists assert that human actions are informed by their past experiences and beliefs; and for this reason, it is difficult to separate experiences from beliefs. Meaning is derived from practical observable consequences and success in practice

which is directly linked to experience; and these can be determined through their actions and intelligence (Creswell & Creswell, 2018; Kaushik & Walsh, 2019).

Khoza (2021b) used the pragmatic paradigm in a study to explore and understand the migration to a DC at UKZN through the use of digital resources. Although the findings indicated that the participants were not aware of their pragmatic identities, Khoza (2021b) asserts that the pragmatic paradigm was the most suitable in interpreting actions of academics and students involved in the migration to a DC at UKZN. The findings were that the participants lacked awareness of personal/pragmatic and natural identities in the process of migrating to the DC. Notwithstanding the findings, Khoza (2021b) maintained that the pragmatic paradigm and the Critical Discourse Analysis (CDA) worked well in the study to interpret actions of academics and students involved in the migration to a DC at the UKZN. The pragmatic paradigm helps researchers to understand people's actions, why things happen and how actions are performed; they have to see results of particular actions. Similarly, in this study, teachers' understanding of the implemented mathematics curriculum in Grade 3 is reflected in the day-to-day teaching practice, and in the results of their teaching, which is learner performance.

Apart from the human experience, people who subscribe to pragmatism believe that there is an objective reality; however, this reality has its roots in people's experiences from their environment. It is driven by both the objective/conscious and subjective/subconscious minds (Kaushik & Walsh, 2019; Khoza & Biyela, 2020). Therefore, it may be argued that it is not objective reality that makes the expert and common understanding to work; rather, it is the user interface, which is the personal/individual view on a particular phenomenon, that determines what works, which is underpinned by individual understanding. For the pragmatic paradigm, reality is fluid; the world is also not static and accepts that there can either be a single or a number of realities (Kivunja & Kuyini, 2017). Reality in pragmatism, according to Kivunja and Kuyini, (2017) and Kaushik and Walsh, (2019), is what works; because reality cannot be achieved once and for all or by just using one philosophical assumption. Therefore, a pragmatic paradigm does not support subjectivity or objectivity, but allows researchers to focus on and embrace both. The aims of the study conducted must answer research questions and provide the useful practicable, reliable, and valid answers that the study requires. For pragmatists, Teddlie and Tashakkori (2009) argue that issues concerning epistemology exist on a continuum, rather than on two opposing poles. Both the researcher and participants have autonomy in shaping the research based on circumstances during the research.

The fluidity of what is real is evidenced in how the world has evolved over time. In education, the school curriculum itself has evolved over time due to many factors. In South Africa, for example, post-1994, teachers had to enact the competence curriculum modelled around outcomes. In this curriculum model, teachers are regarded as facilitators and learners are co-constructors of their learning. Learners are assessed formatively and their competence, not their performance, is what matters. As alluded to in the literature chapters, due to teachers' lack of understanding and difficulties the government faced with this new curriculum, the curriculum was then reviewed. This then led to the introduction of the content-centred performance curriculum, which is currently implemented in schools. In the performance curriculum teachers are to conform and teach as experts, following the sequence of content as laid out in curriculum documents. Teachers must use summative assessments to assess whether learning has taken place.

Recently, the same curriculum underwent instability as the COVID-19 pandemic took control of the world. The curriculum had to be trimmed to ensure that core content and skills are covered. Again, the introduction and utilisation of online learning platforms became the norm. All this proved that truth is relative and is based on what works at a particular point in time. In this study, therefore, the pragmatic paradigm was found to be the most suitable: it embraces the personal identity and individual understanding. Teachers do not necessarily conform to any of the two models of curriculum, but to what works for them, based on the experiences they have in teaching, informed by environmental factors. Hence, Khoza's (2022b) position that teachers who conform to the pragmatic identity use it as an important ingredient that addresses individual/personal needs.

5.2.1.1. Ontological and epistemological assumptions of the pragmatic paradigm

As defined in the previous section, ontology refers to the nature of reality and truth that exists and the assumptions that our researched phenomenon makes sense or sounds real. Unlike the other paradigms that were briefly discussed and articulated regarding their ontological and epistemological assumptions, for pragmatists "a mixture of ontology, epistemology and axiology is acceptable to approach and understand social phenomena" (Wahyuni, 2012, p. 71). This suggests that they are not viewed as separate entities, but as intertwined in interpreting the researched phenomena. The notion of truth and reality is dependent on individuals' views of the two concepts. Given (2008) posits that pragmatism gives reality a privileged position; and adds that truth is not only what works within the prevailing reality but is also relative. Truth, according to pragmatists, is regarded as what is good and what works; and it is not based on a duality

between reality independent of the mind or within the mind (Teddlie & Tashakkori, 2009; Creswell & Creswell, 2018). According to pragmatists, there is no single reality; therefore, each person has a personal interpretation of reality (Kivunja & Kuyini, 2019). There is an external reality independent of the human mind, but people are unsure whether any interpretation of reality is better than the other (Teddlie and Tashakkori, 2009). In pragmatism knowledge acquisition is neither objective nor subjective, but a progressive that caters for both.

In this study, this is evident when participants articulate how they teach mathematics, giving their interpretation of what they believe is working for them in their day-to-day engagements with the subject and learners. This is besides the prescribed mathematics curriculum and its assumptions of what and how they should teach. For teachers, this is their reality because it is their daily lived experience, which Morgan (2014) regards as the progressive interaction of beliefs and action. Teachers are compelled to juggle important teaching content, aligning this with current trends in education. In teaching whatever may be demanded of them by the policy makers, teachers implement what works for them, based on their experience in the field of teaching.

Epistemology is the nature of knowledge that is grounded in our beliefs and assumptions of knowledge and the nature of the relationship between who knows and who is to know about what should be known. On the contrary, Morgan (2014) contends that for pragmatists the nature of knowledge is an active process of inquiry that creates a continual back-and-forth movement between beliefs and actions, but not about an abstract relationship between the knower and the known. Relationships in research are determined by what researchers believe to be appropriate to the study at hand.

5.2.1.2. Methodological assumption of pragmatic paradigm

The pragmatic paradigm uses mixed methods in research to understand human behaviour; therefore, it allows the researchers to adopt either a qualitative or quantitative approach, or both, to interrogate the phenomenon at hand (Kivunja & Kuyini, 2019 & Khoza, 2021b). Researchers tend to use a combination of different methods to address the research questions, e.g., intermingling of interviewing, observation, and document analysis (Kaushik & Walsh, 2019). Some studies rely more on interviews than on observations or vice versa; however, for pragmatists, the best and most suitable method produces desired results and is an acceptable practice, mixing both qualitative and quantitative data to address their research question (Kaushik & Walsh, 2029).

This study uses reflective activities, structured interviews and observations to generate data that will help in answering the research questions. These data-collection methods are discussed in detail as the chapter progresses.

5.2.1.3. Axiological assumption of pragmatism

Research conducted should benefit people; therefore, pragmatic researchers decide what they want to research based on what is important to their value system. Therefore, according to pragmatism, research must be understood as a human endeavour based on the beliefs and actions of researchers (Morgan, 2014). In this study, the researcher found it fitting to conduct a study on teachers' understanding of the implemented mathematics curriculum due to a vested interest in this topic. The vested interest in this case means that, as a district foundation phase curriculum specialist, the researcher finds the phenomenon of understanding in this study important. Underperformance continues to be a thorny issue. This is despite the level of support, and the large number of programmes put in place to improve teachers' pedagogical content knowledge and learner performance in mathematics across the phase. Furthermore, at the end of this study, the findings will benefit the participants and other people who also have an interest in the phenomenon.

Limitations of the pragmatic paradigm are that the researcher's worldview can influence how they conduct their study: it is the researcher who decides which question is to be asked, and which methods are suitable for the particular research. These choices and decisions are influenced by the socio-political location of the researcher, personal history, personal experiences, and personal belief systems. Hence, some researchers (Hussain, Elyas and Nasseef, 2016) claim that, instead of regarding pragmatists as a paradigm, such may rather be considered a research approach or a framework which is not concerned with whether the nature of reality is real or socially constructed.

5.3. Action Research

By now it should be clear that this is educational research focused on studying the process of teaching and learning that explores teachers' understanding in a school setting (Efron & Ravid, 2013). Therefore, as a researcher of this phenomenon, I have a variety of available research methodologies to select from. Hence I adopted the paradigm as it has appropriate approaches that will allow this study to produce the desired results. These approaches focus on the gathering, analysing, and interpreting of data. And for this study I chose an action research.

Action research is commonly described as an investigation carried out by educators in their own contexts to improve their profession and to enhance the learning of their learners. The purpose of conducting action research is that it gives the researchers an opportunity of critically observing a situation with the aim of improving the quality of action within, so that teachers can understand the practical situation, thus solve a particular problem and produce guidelines for better practice.

Proponents of action research (Elliot, 1991; Bartlet & Burton, 2007; McMillan & Schumacher, 2010; Christiansen *et al.*, 2010; Efron & Ravid, 2013) concur that action research is conducted by particular people on their own work. In an educational setting, for example, teachers who take part in action research are interested in studying their own practice within their classrooms or schools. As a chosen paradigm for this study, pragmatism posits that research should be treated as a human experience based on the beliefs and actions of researchers, in this case, the researcher and teachers as participants. These teachers seek to answer research questions that arise from challenges encountered in their practice, focusing on finding solutions to such problems. Therefore, the goal of research is to improve practice and to foster professional growth. This is better achieved when teachers understand the curriculum and their learners; when teachers can solve problems, or develop new skills in their profession. As an interactive process, action research is not much concerned with whether the results can be generalised to any other context besides the one currently being researched. Action research develops a solution that is of practical value to the people or organisations with whom the researcher is working, this being an interactive process (Bartlett & Burton, 2007; Asenahabi, 2019).

Mills, (2003) and Koshy (2005) add that action research works towards achieving practical outcomes, creating new forms of understanding and improvement of practice over a period of time. In the process, teachers are also empowered to develop a reflective practice and to customise the work environment with effective changes. The process of developing a reflective practice is not linear but cyclical in nature. The researcher and teachers engage in an act of planning, acting, and observing, and reflecting on the results of the action (Koshy, 2005). For this study, an action research, therefore, consists of a spiral of action and reflection, taking the following five steps: reflection, planning, action, observe and evaluate. This is important because the aims and objectives of the study are measurable; they allow participants to add on other aspects that are deemed important. Then, because of its cyclical nature, in this study, teachers had to start by reflecting on their understanding of the implemented mathematics curriculum. Then, we (the participants and I), engage in the planning of interviews. The teachers also had to plan and prepare the mathematics lesson to be ready for observation. The action part was for me

to observe the teachers teaching by teaching then evaluate the lesson through analysis. The participants are also expected to engage in the process of evaluating their own practice. In the second phase, teachers had to re-reflect and re-plan. In this case the planning was for focus-group discussion, which was the last part of the actions of this study. The diagram below depicts the action research cycle in the context of this study.

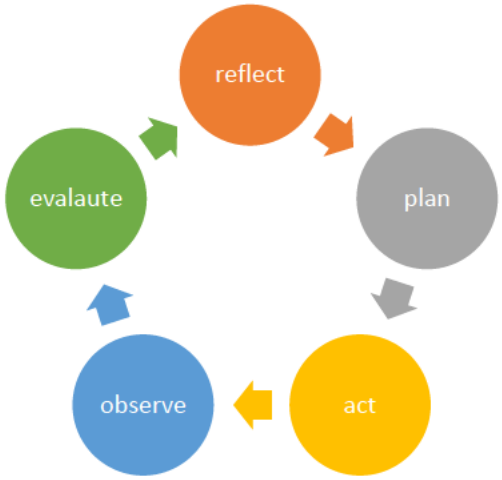


Figure 5.1: The action research cycle

Through these activities, it is expected that the study will be able to answer the two research questions and to some extent, for teachers to improve their practice. I, as the researcher, also had to research my own practice with the aim of ensuring that teachers implement Grade 3 mathematics in the most natural way, using their natural understanding, informed by the NIF. This kind of implementation is way beyond the prescripts of the curriculum which follows the experts understanding or that of society guided by common understanding. How and why they are teaching the way they will be teaching becomes their user interface which promotes their objective reality, as implied in the natural identity framework.

In action research, bias and subjectivity exist as an identified gap, which may pose challenges (De Vos *et al.,* 2011). In the context of this study, challenges that may emanate are that of the relationship I have with the teachers. Such may make it difficult as a researcher to be objective, and for teachers to be open, especially on a one-to-one interaction. In my position as a curriculum specialist, I must monitor and support the implementation of curriculum. To overcome this, I will ensure that I remain neutral. It is also understandable that, due to the size of the sample in action research, its findings cannot be generalised to other settings; instead, it has the potential to improve the participants' practice (Efron & Ravid, 2013). Therefore, the strength of action research lies in its relatability to similar situations (Bartlett & Burton, 2007). According to

Galane (2016), this implies that the findings and conclusions of the research may have close relations to other studies similar to this one elsewhere; however, the findings cannot be generalised as the number of participants was too small. Because of the number of participants in this study, this action research adopts a qualitative approach to research. I, as the researcher, must be conversant with teachers' understanding of the curriculum. Such guides what teachers need to teach within their natural educational setting.

5.4. Qualitative Research Approach

According to Cohen *et al.* (2018), selecting a research approach is not a question of preference, random, or spontaneous decision making, but is a planned process in which the key is the application of the concept of suitability for purpose. Therefore, for this study, a qualitative research approach is deemed suitable, as it provides insights into teachers' understanding of the implemented curriculum, which forms a major part of their practice in their work contexts. Furthermore, data-generation tools used in this research are better suited to qualitative research than to quantitative or mixed-methods research. One may argue that the study has adopted the pragmatic paradigm that advocates for utilisation of the mixed-methods approach to research and of collecting data; however, the researcher has not come across a study in which it is mentioned that pragmatic paradigm studies have to exclusively use mixed methods. For this reason, adopting a qualitative research approach may not fall short of providing rich data based on the methods that are used to generate and analyse data. Of note also is that the pragmatic researcher is not bound to use any specific philosophical assumptions, but only what works for the study (Kivunja &Kuyini, 2017; Kaushik and Walsh, 2019); therefore, a qualitative approach is adopted as one that will suit this study.

Creswell (2018, p. 41) defines a qualitative approach as "a means for exploring and understanding the meaning individuals or groups ascribe to a social or human problem; this process involves emerging questions and procedures, data typically collected in the participant's setting, data analysis inductively building from particulars to general themes, and the researcher making interpretations of the meaning of the data". Hence Tracy's (2020) account that qualitative research's strength draws from the view that this is an excellent way of studying contexts that the researcher is curious about. In addition, it gives a researcher an opportunity to hear and see what people do in their day-to-day lives because it focuses on people's lived experiences. In this study this occurred by conducting the semi-structured interviews, observing all the sampled

teachers when teaching mathematics in their classrooms and engaging in a focus-group discussion.

Qualitative research is therefore regarded by researchers as a systematic subjective approach designed to study situations and events as they unfold naturally, and to give them meaning (Burns & Grove, 2003; Hesse-Biber & Leavy, 2011; Efron & Ravid, 2013). In qualitative studies researchers therefore derive meaning from people's experiences, circumstances, and situations. Engaging with teachers during interviews, observations, and when they complete the reflective activities, it was easy to derive meaning from these engagements. Teachers openly shared their experiences on their understanding of mathematics as a subject, how they are teaching it, going to the extent of sharing why they were teaching mathematics.

When using a qualitative approach, there is a fundamental motivation to conduct research, which gives researchers the autonomy to develop their own way of asking questions and thinking through problems (Hesse-Biber & Leavy, 2010; Litchman, 2011). As a researcher, my objective was to explore teachers' understanding; therefore, questions I developed led to both questions being answered. It is important for me to research teachers' understanding because, as a foundation phase curriculum specialist, I have a vested interest in foundation phase mathematics, as one of the core subjects in the phase. Flick (2009) agrees that the intentions of qualitative approaches are to understand, describe, and explain social phenomena by analysing experiences of individuals or groups, their everyday knowledge, accounts, and stories which can be related to everyday professional practices. Teachers did share their understanding of mathematics in the natural settings of teaching, describing, explaining, reporting teaching of key concepts and theory testing in a natural way.

Despite the qualitative research being suitable for this study, Cohen *et al.* (2018) found that the assumed shortcoming of a qualitative research is that it lacks control and this exposes its methods as unattractive for research synthesis. The researchers therefore maintain that qualitative studies have to be weighted, downgraded, upgraded, or excluded, according to the quality of the evidence and sampling that they contain. Therefore, the researcher must ensure that data relevant to the topic under research is in alignment with the research approach to alleviate the identified gap (Cohen, Manion and Morrison, 2018); correct sampling should be a priority.

5.5. Sampling

Sampling is a process of selecting a sample of units from a data set in order to measure the characteristics, beliefs, attitudes, events, or behaviours of people with which to conduct a study (Grove, 2003; Christiansen *et al.,* 2010; Rahi, 2017). Sampling is, therefore, a way in which the researcher determines who will form part of a population for their research which will represent the whole population of people falling under the same category. This population enables the research to be generalised. De Vos *et al.* (2011) maintain that findings of a research can only be generalised if it can be proved beyond doubt that the observed activities from the sampled participants would be similar in other groups of subjects from the population. Sampling should be based on relevancy of the participants' experiences regarding the topic under investigation and their ability to enable the researcher to gather required data that will contribute to the study (Kerlinger, 1986; Efron & Ravid, 2013). When planning for interviews and observations, the researchers should take into consideration availability of participants and suitable time to be allocated for each activity.

The research population is decided by the researchers who must set the number of people who will form part of that population (Christiansen *et al.,* 2010). These definitions suggest that it is important for the researcher to consider the research topic, the context of the study, and the relevance of the sample to the study to ensure that the sample provides the researcher the opportunity of obtaining multiple perspectives on the issue under investigation. It should also be noted that the type of study conducted, whether it be quantitative, qualitative, or a mixed-methods study, also determines the type of sampling suitable for that study. There is consensus in literature that there are two common sampling techniques, probability and non-probability sampling (Lune & Berg, 2017; Rahi, 2017; Creswell & Creswell, 2017).

On one hand, probability sampling is an approach that is used for quantitative studies; the sample mathematically represents subgroups of some larger population, with each unit having an equal chance of probability for selection (Lune & Berg, 2017; Creswell & Creswell, 2017). On the other hand, the non-probability 'non-random' sampling approach used for qualitative studies is the sampling approach in which the chance or probability of each unit to be selected is not known or confirmed (Kothari, 2004; Rahi, 2017). The researcher targets a particular group, e.g., a small group of teachers, fully understanding that this group does not represent the wider population, only itself (Cohen *et al.*, 2018).

The current study is a qualitative action research; therefore the non-probability sampling approach is identified as the most relevant. For non-probability, as in the probability sampling, purposive, convenience, quota, or snowball sampling may be used. Researchers using quota sampling begin with a kind of matrix or table that creates cells or strata. To create a label for each cell, the researcher may use specific attributes for easy identification of the participants such as gender, age, education, or any other attribute suitable for the study in question (Check & Schutt, 2002; Rahi, 2017; Lune & Berg. 2017).

The other strategy is snowball sampling, in which the researcher has a target group and has already sampled it, already anticipating that he may not gather as much information as needed, the population not being easily accessible (Lune & Berg, 2017). However, to gain more responses, the researcher, after acquiring data from the sampled targets, requests that participants provide him or her with names of other people who may be in the same position (Lune & Berg, 2017). An example of this is the telemarketing industry. For example, telemarketers call someone as an identified target to sell car insurance to, based on their profile from other service providers. After engaging with them, when the targeted person is about to hang up, they ask who the person knows, about 5 people sometimes, who may also need a car insurance policy. Hence De Vos *et al.* (2011) correctly point out that the researcher depends on members of the target population to help him locate other members of that population. For this study, both quota and snowball samplings were not suitable; their focus is on teachers' understanding of the implemented mathematics curriculum in Grade 3. Therefore, I saw fit to use purposive sampling as Cohen *et al.* (2018) posit that purposive sampling is a key feature of qualitative research.

Purposive sampling is a sampling strategy in which the researcher uses own judgement, special knowledge or expertise to select a group of people who know about the problem to represent this population (Parahoo, 1997; Lune & Berg, 2017; Rahi, 2017; Tracy, 2020). Researchers should purposefully sample participants who match the requirements of the project's research questions, goals, and purposes (De Vos *et al.*, 2011 & Tracy, 2020). Therefore, when developing a purposive sample, the researcher uses their special expertise of a certain group to select subjects who represent this population (Lune & Berg, 2017). Another positive attribute of purposive sampling is that it is cost- and time-effective (Lodico, Spaulding and Voegtle, 2010; Lune & Berg, 2017; Tracy, 2020). For this study, purposive sampling is the most suitable, as the sampled Grade3 teachers are assumed to be the most suitable to answer the study's research questions.

The relevance of using purposive sampling in this study is that all the sampled teachers are working for the Mpumalanga Department of Education, Nkangala District in KwaMhlanga. They are all teaching Grade 3 in various primary schools around the area. At the beginning of this study, the sampled teachers were the most accessible and relevant as I was their mathematics subject advisor. Therefore, it was not a challenge to access these people − they were readily available. However, in the middle of the study I was promoted and moved to Gauteng. At first it seemed as though it was going to be a challenge to access all participants. Due to advanced technological resources accessibility, this did not become a challenge; I therefore continued with the sample.

Reasons for retaining the sample were to explore their understanding of the implemented mathematics curriculum after the level of support provided to them, and also based on the diverse population of learners they teach. The languages used for learning and teaching in the foundation phase in KwaMhlanga are IsiNdebele, Sepedi, and English. In addition, the province's performance continues to be on the downward spiral. Recently it has been aggravated by the impact of COVID-19. Lastly, these teachers have a wealth of experience and are qualified to teach in the foundation phase. Therefore, as a foundation phase curriculum specialist, I will be assisted by this information to generalise subjectively from the case being studied, drawing from my own experience as a mathematics subject advisor. The profiles of the sampled teachers are tabulated below:

Table 5.2: Profiles of Participants

Participants	**Gender**	**Age**	**Designation**	**Years of experience as a classroom educator**	**LoLT**	**Highest Qualification**	**Race**
Teacher 1 (P1)	Female	55	Deputy Principal	32	Sepedi	BEd Honours: Education Management, Law and Policy	African
Teacher 2 (P2)	Female	48	Acting Departmental Head	18	English	Junior Primary	African

						Teachers' Diploma	
Teacher 3 (P3)	Female	54	Deputy Principal	31	Sepedi	BEd Honours: Education Management, Law and Policy	African
Teacher 4 (P4)	Female	56	Departmental Head	29	IsiNdebele	BEd Honours: Education Management, Law and Policy	African
Teacher 5 (P5)	Male	34	Teacher	5	IsiNdebele	BEd: ECD & Foundation Phase	African
Teacher 6 (P6)	Male	31	Teacher	5	IsiNdebele	BEd: ECD & Foundation Phase	African

Based on the information provided by the teachers, their age in years is between 31 and 54. The teachers' classroom teaching experiences differ, with two youngest teachers, P5 and P6 being males, having less than 10 years of teaching experience; the rest are females and have more than 10 years' experience as teachers; with participant 4 having 35 years of teaching experience. P5 and P6 are a cohort of teachers who studied a four-year full-time undergraduate degree in foundation phase teaching. P1, P3, and P4 furthered their studies part time in various educational institutions. P2 only has a Junior Primary Teachers Diploma obtained while she was studying full time when there were still colleges of education. In addition, P1, P3, and P4 are in school management positions, with P1 and P3 being deputy principals; and P4 being a departmental head.

All the sampled teachers are African; this does not imply that in the district there no teachers of other racial groups. In KwaMhlanga, as mentioned earlier, the population is mostly Africans. Of note also is that P1, P3, P4, P5 and P6 teach mathematics in an African language, either IsiNdebele or Sepedi. It is only P2 whose school offers mathematics in English. Except for P2, P5, and P6, the other teachers have all experienced the curriculum reform from pre-1994 to post-

1994. Based on the above information, the teachers' responses will generate data that will provide answers to the research questions of this study. This will only be possible if relevant data-generating instruments are utilised.

5.6. Data-generation Instruments

This study adopted qualitative data-generation methods because action research by its nature may use either qualitative, quantitative, or mixed methods. (Shah & Al-Bhargi, 2013). Qualitative methods are described by Tracy (2017, p. 24)) as "an umbrella phrase that refers to the collection, analysis, and interpretation of interview, participant observation, and textual data in order to understand and describe meanings, relationships, and patterns". It is acceptable in action research to use any technique suited to generating data. For this qualitative action research, data was generated using reflective activities, semi-structured interviews, and classroom observation. Data was first generated by using reflective activities.

5.6.1. Reflective activities

Mabuza (2018) posits that a reflective activity is an important tool that encourages transparency during the research process, which makes it a useful instrument for readers. A reflective activity is presented as a written activity in which participants write answers to questions provided to them about their practice in a reflective manner (Milam, 2008). For the purpose of this study, these activities were used to give teachers opportunities to reflect, while at the same time I gained insights into their understanding. The following questions, directly linked to the concepts of the curricular spider, were asked: Why are you teaching mathematics? Towards which goals are you teaching mathematics? What mathematics content are you teaching? What resources are you using to teach mathematics? When are you teaching mathematics? How are you teaching mathematics in Grade 3? What are your roles as a mathematics teacher? Who are you teaching? Where are you teaching? How is the implementation of Grade 3 mathematics assessed?

The reflective activity, according to Mabuza (2018), prompts teachers to reflect on their practice, or on what they are doing, how they are doing it, and why they are doing it. Therefore, it is through reflections that a study may start to take shape. The reflections open doors to explore issues from another point of view, which may lead to teacher development or improved teaching practice, as observed by (Galane, 2016). In this study, reflective activities are relevant as this is a pragmatic paradigm action research. Teachers, in answering the research questions of this study, have to respond to the 'why' questions using the natural understanding framework which focuses more on the teacher − questioning how they are doing things in their day-to-day practice,

and aligning this with their natural understanding which includes their beliefs, experiences, and their natural way of doing things. The findings consider the available evidence and help the researcher and participants to develop solutions and suggestions for future actions (Reason & Bradbury, 2008). The researcher designed the reflective activity. Before giving it to the teachers, the activity was explained in detail telephonically to each participant, and later emailed to them to complete.

To avoid the research activities hindering teaching and learning, the teachers were requested to complete the activities in their own time. The researcher arranged with the participants to email these. For those who were unable to return the answers per email, it was agreed that I would collect them when I conducted the one-on-one interviews there. Five of the six participants completed the reflective activities. The sixth participant said he would email the information because he had not had time to complete it. Despite being given ample time to email it to me, he did not do so. I did not persuade him as I was respecting his right not to complete the questionnaire. Completion of the activities seemed not to be challenging as the questions were directly related to the curriculum and their daily teaching practice. After submission of the activities, I then arranged for the interviews.

5.6.2. Semi- structured interviews

Interviews are one of the many data-collection techniques used by researchers who apply a qualitative methodology. A qualitative interview is defined by Babbie (2020, p.314) as "a conversation in which the interviewer establishes a general direction for the conversation and pursue specific topics raised by the respondent". Christiansen *et al.* (2010, p.65) define an interview as "a conversation between the researcher and the respondent it is a structured conversation where the researcher has in mind particular information that he or she wants from the respondent and has designed particular questions to be answered". Based on the two definitions, it may therefore be concluded that an interview is an oral transactional activity between the researcher as an interviewer and the participant as an interviewee. Furthermore, an interviewer, the one who drives the whole process, may be regarded as a person who has more power over the interviewees, which may at some point sour the relations. Although an interview is conversational, this is not an everyday conversation taking place because it is a constructed and planned event (Berg, 1989; Kothari, 2004; Cohen *et al.*, 2018).

An interview is the closest an interviewer can be in realistic contact with the participants in order to understand how they think and feel about a topic under research and beyond. (Terre Blanche

et al., 2006). Therefore Berg (1989) maintains that interviews are conducted for a specific purpose in which the researcher conducts interviews to obtain information from the respondents. Depending on the type of interview conducted, one-on-one interviews generally involve two people. The interviewer is there to ask the interviewee questions, so that they respond and explore what has been asked. The interview is a flexible tool for data collection and it affords participants the opportunity of using multi-sensory channels (Cohen *et al.* (2018). Popularly used types of interviews include the semi-structured, structured, and informal interviews. To fulfil the aims and objectives of the current study, semi-structured interviews were used Berg (1998).

Semi-structured interviews are used by researchers to validate already existing findings from other sources (DeJonckheere & Vaughn, 2019). The two literature chapters of this study extensively discussed the understanding phenomenon critically from both the teachers' expert and common understandings, already providing a clear picture of their understanding of the mathematics curriculum in Grade 3. Semi-structured interviews are feasible for detailed and extensive conversations. One advantage is that "the researcher can prompt and probe deeper into the given situation" (Karjorm, Boon, 2005, p.6). The strength of a semi-structured interview "lies in its ability to blend closed- and open-ended questions, often accompanied by follow-up probing questions" (Adam, 2015, p.493). This allows the interviewees to explore their personal experiences, beliefs, and perceptions relating to the discussed topic. In addition to probing and prompting, Soldan (2014, p.2) assured that this provided richer context and was easier to process. During interview sessions, when participants answered, as a researcher I had the opportunity to ask probing questions to gain a clearer understanding so as to not misunderstand their responses. On this note I was also guarding against being too flexible in closing language barriers. Soldan (2014) identified these as some weaknesses of interviews. Soldan (2014) argues that overly much flexibility may compromise the validity of the study; and language barriers may lead to loss in translation.

The shortcoming of interviews as noted by (Adhabi & Anozie, 2017; Alamri, 2019) are that interviews are time consuming, needing to be recorded and fully transcribed, which may compromise the quality of data − meaning may be lost during transcription. In addition, it may be difficult to adhere to the scheduled time of the interview due to unforeseen circumstances, such as travelling to the interview venue, or lack of funds to transport the interviewees or yourself (Adhabi & Anozie, 2017). For the purpose of this study, I addressed these shortcomings by travelling to the participants' schools so that none of them incurred a financial burden.

5.6.3. Focus group

Participants are purposefully selected to take part in a focus group because they share a common feature relevant to the study's purpose (Terre Blanche *et al.*, 2006; Coghlan & Brydon-Miller, 2014; Nyumba *et al.*, 2018) and for the purpose of this action research, participants were all Grade 3 teachers, teaching mathematics as one of the subjects. The purpose of the study is to explore teachers' understanding of the implemented mathematics curriculum. Furthermore, focus group "aims to obtain data from a purposely selected group of individuals who will participate in the study; rather than from a statistically representative sample of a broader population" (Nyumba *et al.*, 2018, p. 20). Unlike a one-on-one interview, a focus group is an interview conducted with a group of between 6 to 10 people who share similar experiences and common characteristics, to enhance understanding about a particular phenomenon. (De Vos *et al.*, 2002; Holloway and Wheeler, 2003; Terre Blanche *et al.*, 2006, Lodico *et al.*, 2010; Coghlan & Brydon-Miller, 2014). The reason for having a small number of participants in a focus group is that it makes it easier for the group facilitator to effectively elicit the breadth of responses that distinguish focus groups as a useful data-gathering strategy. Furthermore, it allows participants to share their insights without feeling intimidated. One of the strengths of focus groups is the empowering of participants to speak out in their own words, encouraging groups, rather than individuals, to voice opinions in relation to the topic under research. Participants in this study were all free to open up and contribute to the discussion from beginning to end without fear of victimisation or bias.

De Vos *et al.* (2002) and Lodico *et al.* 2010 refer to this as focused, because it involves a joint activity which is useful for promoting voluntary resonance of views from participants. During interactions, participants are afforded the opportunity of building their views on other participants' contributions. Such supports production of insights that may not occur in one-on-one interviews, but are unique to the focus group. Lune and Berg (2017) assert that during focus-group discussions, other participants benefit from hearing how one group member responds to another without disrupting underlying normative group assumptions. In addition, meanings emerge from participants' interests, rather than those of the researcher, and are socially constructed rather than individually created.

The focus group may also be a learning curve for the researcher as there will be other issues that were not anticipated but arise during the focus-group discussion. Dlamini (2022) assert that the

focus group has the potential of generating rich, in-depth data if it is well organised by the researcher. Therefore, the success of the focus group is dependent on planning which includes participants' availability to take part in the focus group; time, accessibility, questions that will be asked, how they will be recorded, and how the responses will be transcribed (Sim & Waterfield, 2019; Nyumba *et al.*, 2018). In this study, the focus group supported me in eliciting in-depth data of the participants' understanding of the implemented Grade 3 mathematics curriculum.

For this study, the focus group was planned to be conducted during the initial stages of data generation. Due to COVID-19 restrictions, even after regulations were relaxed, I decided to retract the group setting because participants were not comfortable with meeting this way. The focus group was replaced by observation of teachers in practice, which complemented the study as it adopted a pragmatic paradigm. Interviews were also conducted one on one, face to face without challenges. The NIF was used as a framework of analysis which also complemented the curriculum concepts and the three propositions of teachers' understanding which are the expert, common, and individual understandings. When analysis was finalised, teachers' understandings of the curriculum were not providing desired results, which I viewed as a gap in the study, it being a pragmatic action research. I then decided to conduct focus-group interviews to give participants the opportunity of expressing themselves in terms of what they understood, supported by other participants. I requested consent from participants for conducting an online focus group, using MS Teams. Online focus groups are not new phenomenon in research and have no significant difference from the face-to-face focus-group discussion, but they emerged when the internet was introduced and were used to complement the traditional methods (Nyumba *et al.*, 2018). Nyumba *et al.* (2018) add that an online focus seems to be a solution to all the challenges experienced with face-to-face interviews due to their dynamic, modern, and competitive nature. However, challenges of lack of connectivity and loss of internet connection during the focus group may pose difficulties in using this method. In this study, during the focus group, one participant was not able to be part of the discussion due to load-shedding; however, the focus group took place regardless.

According to Terre Blanche *et al.* (2006) certain procedures have to be followed to level the ground for the discussions that will be taking place. Participants' expectations, ground rules for the focus group and how confidentiality will be maintained are discussed during this time. Other issues that are covered include respecting other participants' contributions and views and also taking turns to speak. For the purpose of this action research, the procedure was explained to the

teachers. The logistics of the focus group were discussed beforehand with the participants, just after they joined the MS Teams platform. I explained to them that the discussions would be recorded on the MS Teams; and the length of the focus group will be between half an hour and an hour. Time had to be kept shorter because (Nyumba *et al.,* 2018) opine that when discussions are longer, participants are likely to suffer from fatigue and this may lead to loss of concentration. Participants were encouraged to participate maximally during the discussion.

The next step was to do a recap of why I called participants for the focus group, the purpose of the study, the previous data-generating sessions we had had, i.e., reflective activities, interviews, and observations. The deliberations during focus-group discussion builds on the content that is presented and follows a format of semi-structured interviews, hence a focus-group discussion is sometimes seen as similar to the one-on-one semi-structured interview (Galane, 2016; Nyumba *et al.,* 2018). During introductory remarks and setting the tone for the focus group, I explained to the participants that the questions that would be asked were the same as those asked during interviews; and that they would still be open-ended and more probing.

A number of researchers have claimed that, although focus groups are more effective in gathering quality data, they have their own shortcomings. Firstly, they are regarded as more time-consuming and expensive to hold (Lodico *et al.,* 2010; Lune & Berg, 2017; Khothari, 2004). This was not the case for this study. Time was well managed and agreed upon beforehand. The whole exercise was cost-effective because all participants have internet connectivity. However, had the focus group taken place during the initial stages of data generation, connectivity would have been a challenge: most participants were unable to connect to online platform due to connectivity problems or lack of technological skills. Secondly, some introverted participants may be overshadowed by those who are outspoken and seem to know more. This limitation was addressed by explaining to participants that they all had to take part. I also ensured that during the discussions each one had something to say, and felt comfortable enough to say it. This goes back to respecting each other's opinions. This process was then followed by analysis of data.

5.6.4. Observation

Observation is a process of collecting data in contexts in which events occur. Based on this we make judgements (Koshy, 2005; Cohen *et al.,* 2018). In this study that process took place in school contexts. Observation, by its nature, is regarded by researchers as a powerful research tool. Observation gives the researcher the opportunity of collecting first-hand data from naturally occurring settings. Gorman *et.al.,* (2005); Koshy (2005); Efron and Ravid (2013) and Cohen *et*

al. (2018) maintain that observation gives the researcher a way of looking at a natural setting purposely and directly; because during observation the researcher gains insights into the authentic life of schools and classrooms.

During observation, judgement is made based on the researcher's awareness of the participants' gestures, body language, and behaviour. Such may be non-verbal behaviour or behaviour occurring in either non-natural or natural settings. This therefore supports Khoza and Biyela's (2019) study conducted with the purpose of exploring and decolonising students' knowledge of technology, pedagogy, and content in the learning of first-year BEd mathematics. In the study the researchers maintain that observation served the purpose of answering the 'how' questions. Participants were observed in action so as to generate the answers on how they used their technological, pedagogical, and content knowledge in learning mathematics. Similarly, in this study, participants were observed in practice, teaching. This focused on how they were teaching the Grade 3 mathematics; how the lesson was structured and how activities and assessment are managed during the lesson. It should be noted that the process of observation will be informed by the nature of observation conducted, whether it is structured, unstructured, or semi-structured.

In structured observations, according to McLeod (2015), the researcher, who is the observer; already knows what to observe and sets the observation criteria in advance. Accordingly, in structured observation, the researcher does not deviate from the observation criteria; the observation can be used to collect both qualitative and quantitative data (Koshy, 2005). By contrast, in unstructured observation, the observer does not have a set criterion on what to observe. The observer may go out to conduct observation; the findings of what is observed will then inform the significance of the observation to research, which is classified as hypothesis generating rather than hypothesis testing (Efron & Ravid, 2013; McLeod, 2015; Cohen *et al.,* 2018). In the same breath, there is semi-structured observation, which is also classified by researchers as hypothesis generating. However, what distinguishes semi-structured from unstructured observation is that it allows for flexibility during the observation process to record both comments and unexpected outcomes.

In this action research, semi-structured observation was used because of its flexibility of recording what is observed. The unexpected outcomes make it the most suitable for action research. The purpose of using a semi-structured observation is that the teachers, who are participants in this study, were to be observed in action: what were they doing in the classroom when they were teaching a mathematics lesson to Grade 3 learners in a natural classroom setting?

As alluded to earlier, the main focus was on how participants teach. This criterion was therefore illuminated in lessons observed on the six participants. As much as participants have roles to play in the observation, the researcher, as an observer, also has to play one of the roles aligned with observation as a data-generating instrument.

As the observer, the researcher can therefore either play the role of complete observer, participant as observer, observer as participant, or complete participant (Cohen *et al.*, 2018). Firstly, a complete observer is explained as one who conceals their identity as an observer but may gain insider knowledge of the group. However, this observer lacks the necessary objectivity to observe reliably. The observer may also be resented by members of their group when they find out about the observer role. Secondly, when playing the participant-as-observer role, the observer has knowledge of the group, which means having insider information. The researcher therefore makes their intentions to observe transparent but runs the risk of not gaining confidential data from participants. The third role involves the researcher playing the observer as participant. In this case, the researcher is not a member of the group, has minimal participation in the group's activities but makes the role as a researcher overt and clear. However, the researcher's access to the participants may be restricted. The latter role is evident in Khoza and Biyela's (2019) study: when conducting semi-structured observations, both researchers were participant observers. One was an insider observer while the other was an outsider. The insider observer was working with the students daily, while the outsider observer was not working with them. The two roles had a positive impact on the observation activity, as they contributed to ensuring that the insider was not subjective, and the participants fully cooperated by not hiding data from the outsider.

Similarly, Kgothego (2020) conducted a qualitative, interpretive case study with the purpose of investigating the role of lesson study in developing teachers' mathematics content and pedagogical content knowledge in the foundation phase. Kgothego (2020) used semi- structured observation as a participant observer playing the role of an insider; the researcher was actively involved in the participants' daily activities, those of teachers. This means that the participants were aware of her interests as the researcher and gave full cooperation during the observations. Notwithstanding the positive effects of observation, a number of observation shortcomings identified by Koshy (2005) and Davin and Staden (2005) are that there may be a temptation to leave out critical details if items are not put on a checklist. One needs a great deal of information to make reliable interpretations. Observations are also regarded as time-consuming because the researcher has to observe all planned activities within a given time frame. During observation the researcher may miss valuable information if there are interruptions, especially background

noise and disruptions. Lastly, information recorded after the actual observation may not be reliable − one may forget some of the details of what was observed.

Kgothego (2020) admitted that using observation as a data-collection method has its own challenges: it is a complicated research method that required her to play several roles. In her case, as a researcher, she had to participate in the lesson study process, make video recordings, and at the same time observe the lessons and take notes. This, according to her, made it difficult for her to observe; hence the decision to use video recordings. The video recording as an observation tool, therefore, assisted the researcher to re-visit the video recording. The researcher admits that this assisted her to observe the interactions and decisions taken during the planning and reflection sessions long after the activity was observed (Kgothego, 2015).

Similarly, in this study, initially, direct observations were the preferred and planned data-generating tool. However, video observations took precedence for collecting observation data due to unforeseen challenges experienced by the researcher. As a researcher, plans were made with the participants for the direct observations to take place, with dates set. However, due to the competing priorities of my work and research, I was not able to conduct the face-to-face observations. I would not be able to attend the observations. Therefore someone, preferably a colleague, would be asked to video record the lessons while participants were teaching. I would then observe the recordings at a later stage.

Prior to the video recordings, I arranged for an online MS Teams meeting with participants. I explained that, as agreed, they still needed to plan and prepare a Grade 3 mathematics lesson to teach, choosing a topic aligned with the annual teaching plan content for the term. Another aspect discussed was the standard lesson plan format. I reminded participants not to omit the important components of a mathematics lesson. Also, of importance was discussing with participants that they should ensure that the videos remained in their possession and would not be shared with anyone until such time as I was able to fetch them. This was mainly to protect the learners' identities and to maintain confidentiality. It is noted that recording of learners without prior permission from their parents may have a negative impact on ethical issues of this research. However, this gap is closed by ensuring that the videos are not shared with any person. I am the only one who will view them. I am entitled to view these learners in my capacity as subject advisor. I am the only one who will be analysing the data. Also, I will safely keep recordings on my employee external hard drive until such time I am sure that they will not be needed; thereafter

I will delete them. This may be a period of approximately two years after conducting this study. The video-recording process was successful.

There is consensus in literature (Koshy, 2005; Efron & Ravid, 2013; Cohen *et al.*, 2018; Kgothego, 2020) that video observations are becoming more popular tools used in research as, firstly, video-recording tools are cheap and easily accessible in present times. Secondly, video recordings provide a permanent record of activities that can be viewed. These devices provide powerful images of events detailing participants' natural behaviour, participation of both teachers and learners, gaze, posture, behaviour, gestures, and body language. This became possible in this study as all the participants ensured that they planned and presented the lessons, and that the lessons were recorded. The lessons were well captured in the videos; however, Participants 1 and 4 had to re-record their lessons due to the poor quality of videos and limited memory of their devices, respectively. From my side, I was able to collect and watch the videos, making notes based on my observations. The former statement is consistent with researchers' concerns about the challenges of using videos for data collection.

Other identified weaknesses of video recording by researchers (Koshy, 20025, Efron & Ravid, 2013; Cohen *et al*., 2018) are that, during recording, participants' concentration may be distorted. Again, the recorded participant's behaviour may be different from their natural everyday behaviour in the classroom. They will have a need to change their behaviour to make it socially acceptable in front of the cameras. In the videos, for this study, this was evident. During the teaching activity, participants were making it obvious that they were not acting normally, for instance, not reprimanding learners who were inattentive, as they would in an unrecorded lesson. This may be problematic in producing reliable data. The participants' actions are simulating what they think is correct; however, it was noted as the lessons progressed, that they were not able to keep up the pretence; their actual practice surfaced towards the end of most lessons. Other gaps related to recording are the quality of the devices, the expertise of the recorder, the position of the camera, and ethical considerations during recordings (Cohen *et al.,* 2018).

5.7. Trustworthiness

In qualitative research, the researcher has the responsibility of establishing credibility, transferability, dependability, and confirmability, which are all under the umbrella of trustworthiness. Trustworthiness is reflected in the researcher's intentional and careful consideration of the various aspects of the study. Trustworthiness has its foundations in utilising

techniques that give truth value, consistency, applicability, and neutrality to a study and its findings, with the aim of supporting the argument that the findings of the topic under research are worth paying attention to (Lincoln & Guba, 1985; Milam, 2008). Trustworthiness is therefore regarded as a truth value of a research. Trustworthiness is dependent, not only on its strength in digging deep into participants' knowledge, but also on the extent of participants' experiences (Holloway and Wheeler, 1996; Streubert and Carpenter, 1999).

In this qualitative action research, trustworthiness is established through triangulation of data from reflective activities, observations, and interviews. Triangulation occurs when a researcher uses various data-generating methods, as mentioned above, to validate the findings of a study. Therefore, using the three data-generating methods supported the study's credibility, transferability, dependability, and confirmability, as the pillars of trustworthiness.

5.7.1. Credibility

In a qualitative research, Guba and Lincoln (1994) maintain that credibility is the researcher's ability to interact with participants for a longer period, using continuous observations and other methods of triangulating the data. To maintain credibility, the data-collection methods were presented to the university's defence panel during the proposal defence. Therefore, the use of reflective activities gave meaning to what teachers, as they reflect, regard as their own understanding of the implemented mathematics curriculum. The findings of the reflective activities were discussed with the participants prior to making them final. Their understanding was further explored during semi-structured interviews. Participants were able to consciously share what they regarded as understanding; they had the opportunity to add information, the questions asked being open-ended and probing. My observation of the teaching helped me to evaluate their competence in the teaching of mathematics. This included how they teach and engage with learners. The examples they give speak to their experience in the teaching of mathematics. To ensure credibility of the interviews, teachers were recorded by means of a voice recorder; and observations were video recorded. The findings, therefore, had the potential of being transferable.

5.7.2. Transferability

There is consensus in literature that transferability is the extent to which the research findings can be applied to other settings or contexts outside the current research context. Tracy (2013)

posits that transferability is when the readers are presented with the findings of the study and in the process of interrogating the findings, relate the findings presented to other situations familiar to them. In this study, the researcher moved to another province which is not the province where the actual study took place. Readers who are interested in curriculum and how teachers implement it may use these findings to evaluate whether they can apply it to their context. This may be possible: Tracy (2013) points out that readers may appreciate the study's findings and then intuitively apply these to their own situations. This may not only be applicable to the teaching of mathematics; the findings may also be used in the context of language teaching.

5.7.3. Dependability

Creswell (2003, p. 220) defines dependability as "the extent to which the same findings can be repeated should the same research instruments be used with similar respondents under similar conditions." This implies that no matter how many times the research is conducted with the same participants, using the same instruments, the findings will be very much the same. However, it may be argued that the above declaration may be possible if we do not find ourselves in the situation we were in during the past two years when COVID-19 became a global pandemic. Mabuza (2018) maintains that dependability is likened to reliability in quantitative studies; however, the researcher further cautions that using people as subjects has multiple interpretations of what they deem real. People's interpretation of reality is informed by their personal experiences; how they view the world, their environment, and cultural beliefs (Mabuza, 2018).

For this reason, dependability may pose some challenges, human behaviour hardly being predictable. Similarly, in a pragmatic action research, the consistency of findings may not be guaranteed. In this study because in an action research, people's way of seeing things evolves over time. There may therefore be some changes in how teachers view and do things later after reflections. This would be due to their improved understanding of reality and how and why we teach not being static, but fluid. To mitigate this, the researcher used a number of data-generating methods that tapped into the participants' way of thinking and the actions they take, and why they do what they do, without influencing their decisions.

5.7.4. Confirmability

Elo *et al.* (2014) describe confirmability as the researchers' ability to detach themselves from the findings in that, the data that the researcher has analysed and presented, are the results of what

participants provided and the researcher has not in any way tampered with data. This implies that the data presented accurately represent the information that the participants provided; interpretations of those data have not been invented by the researcher. Furthermore, the findings of the study reflect the participants' voice and conditions of the enquiry, and not the researcher's biases, motivations, or viewpoints. In agreement, Guba & Lincoln (1994) and Pool and Reitsma (2013) aver that confirmability is the extent to which findings of a study are free from bias, which suggests that the findings should be a true reflection of the participants' experiences and ideas without being influenced by the position of the researcher.

Similarly, I ensured confirmability by presenting the data and findings that were gathered from participants through the use of data-generation tools discussed in Chapter Five of this study. I also considered that confirmability may be compromised because of my position as a senior curriculum official in another province. Furthermore, apart from being a curriculum specialist in another province, I am a former subject advisor who monitored and supported these teachers for a period of five years on curriculum implementation in the foundation phase when I was still working in Mpumalanga. For these reasons, from the outset, I made the aims and objectives of conducting the study transparent to these teachers. I also explained that, as classroom teachers, they were better positioned, with their experience, to answer the research questions of the study informed by their experiences and by the wealth of knowledge they have in teaching the foundation phase.

5.8. Data Analysis

Data analysis is an ongoing process during research. The researcher should, from the start, have a plan on how data will be analysed. The processes of collecting and analysing data cannot be separated when writing is a method of enquiry (Denzin & Lincoln, 20). To make sense and meaning in research, the researcher has to observe participants' actions, because meaning is inherent in those actions (Milam, 2008), hence the use of observation in this study. Furthermore, the procedure of analysing data must be appropriate to the kinds of data generated; it involves analysing participant information. Researchers typically employ general analysis steps as well as those steps found within a specific design. For the purpose of this study, the steps followed were to first give participants reflective activities, then to observe them when they were teaching; then later, to conduct semi-structured interviews. These data-generation methods are all suitable for a pragmatic qualitative action research.

During the data-generation and analysis process, there are three concurrent activities key to qualitative data analysis. These are data reduction, data display, and conclusion-drawing (Miles & Huberman, 1994; Koshy, 2005; Lune & Berg, 2017). These researchers concur that collection of qualitative data may leave the researcher with volumes of data that must be sorted and organised in workable portions. For these reasons, data reduction, therefore, focuses its attention on the need to simplify and transform raw data into a more manageable form; this process occurs throughout the life of the research project.

Categories were determined in advance and taken from the phenomenon of this study, which is teachers' understanding of the implemented mathematics curriculum from the expert, common, and individual perspectives. The responses from reflective activities were categorised using the ten components of the curricular spider web. Also, during interviews the recorded responses were transcribed, making them more manageable. The specific statements extracted help to formulate the meaning of the transcribed data. The transcribed interview data was then showed to the participants to validate its correctness, checking that nothing had been omitted based on what participants had said during the interviews. Lastly, the observations, informed by the teachers' personal identity from the natural identity framework, were also summarised in terms of how the teachers carried out the teaching process to showcase their understanding. The researcher took notes and recorded selected data related to the teachers' practice, distilling key points of the phenomenon, reducing complexity without violating it, catching the essence of the issue or the situation. This enabled the researcher to identify, for example, patterns, key issues, causal processes, and sequences (Cohen *et al.*, 2018, p. 643). The whole process is also called coding of the actual data; this takes place when the researcher transforms raw data and codes it (Berg & Lune, 2017). This process then led to data display. Data display occurs when the researcher uses textual representations of data for the purpose of selecting segments that best illustrate the concepts of interest (Mezmir, 2020, p. 20). Therefore, after following all these processes presented above, findings were ready to be presented.

5.9. Ethical Issues

"Ethics in research are very important, particularly with research involving humans and animals" (Christiansen *et al.*, 2010, p. 50). There are certain principles that the researcher has to follow when dealing with ethical issues. Berg and Lune (2018) maintain that social science researchers have an ethical obligation to their participants and other members of the community where their

research is taking place. Their research involves people and to some extent tapping into their spaces and privacy. Therefore, though part of data-generation processes started during Covid-19, this study did not in any way harm the participants or expose them to any kind of danger.

Firstly, I applied to the Mpumalanga Head of Department to conduct the study in the province. I obtained an approval that gave me permission to conduct the research. Before the start of interviews, I also obtained permission in writing to conduct the study in the district from the Nkangala District Director, explaining the nature of the study with the following principles of ethics: that confidentiality, anonymity, and consent would be dealt with during the study, giving the method of such. For both requests, I emailed the letters requesting permission and later submitted hard copies to the respective offices.

For the participants, I first presented them with the informed consent forms. I explained that I was conducting a study on teachers' understanding of the mathematics curriculum in Grade 3. Therefore, I asked these people to consent voluntarily to be part of the research − they had been identified as relevant people for participation in the study. Informed consent is explained by Lune and Berg (2018) as individuals' knowing consent to participate as an exercise of their choice, free from any element of fraud, deceit, duress, or similar unfair inducement or manipulation. Informed consent concerns participants' autonomy; and it arises from their right to freedom and self-determination in the research (Cohen *et al.*, 2018).

The consent includes a clause which informs participants of their safety during the research period. Confidentiality of participants was ensured in writing; and their identity, was protected by not mentioning their names, but by referring to them as Participants1 to 6. I requested participants to fully read the consent form, ask questions where necessary and to sign the form. According to Christiansen *et al.* (2010), when one conducts a research, it has to benefit the researcher, participants and other stakeholders who have an interest in the topic under research. Therefore, I anticipated that the research may be beneficial to the teachers, curriculum specialists, learners, communities, other stakeholders in education, and the education system as a whole.

5.10. Limitations

Limitations are possible hindrances that may impact negatively on the research. They may be anticipated or come as a surprise during different stages of research. Creswell and Creswell (2018) posit that limitations often attach to the methods the study has adopted for sampling. This

can be a larger or smaller sample size; data-generation methods and data analysis. These represent weaknesses in the research that the researcher acknowledges so that future studies will not suffer from the same problems. Over and above acknowledging the limitations, potential alternative explanations for the study findings should be presented.

For this study, the main limitation was time, interruption of school activities, and utilisation of the focus group as a method of data generation. To overcome this, I asked participants to complete reflective activities, returning these via email, avoiding my travelling to Mpumalanga. To avoid interruption of contact time in schools, the research focusing on teachers, I slotted interviews to take place after school or very early in the morning before school starts, i.e., between 07:00 and 07:45. Due to the COVID-19 pandemic, it became difficult to access a group of teachers face to face. Organising a virtual interview was more challenging, as some of the participants did not have access to the internet or had little or no knowledge of online platforms. Therefore, I initially replaced the focus group with observation of video recordings of teachers teaching a mathematics lesson in their classes. There was no inconvenience, as teachers taught lessons that they had prepared to teach, ensuring that their lessons were video-recorded. I then played the videos and observed the teaching. Issues around video recording while learners are in class have been considered. However, it should be acknowledged that the videos are not going to be published at all. The videos are being used solely by the researcher for observation and analysis purposes; they will be discarded after their time frame of storage has expired. When teachers were capacitated on how to use online platforms, focus group was then conducted using MS Teams.

5.11. Conclusion

This chapter discussed the research design of this study, which included the methodology underpinning this study. The chapter also presented the pragmatic paradigm and discussed its ontological and epistemological assumptions and their relevance to action research. Data-collection methods, reflective activities, observations and interviews were also discussed. Credibility, transferability, dependability, and confirmability were maintained as outlined. Furthermore, the chapter presented the way in which data will be analysed; ethical considerations and limitations, and how to deal with limitations were included. The next chapter will be presenting data analysis and discussion of the findings.

CHAPTER 6

EXPLICATING TEACHERS' UNDERSTANDING THROUGH REFLECTIONS AND ACTIONS, ANSWERING THE 'WHAT' AND 'HOW' QUESTIONS

6.1. Introduction

The previous chapter presented the research design and methodology underpinning this study. It first discussed the pragmatic paradigm and its significance in action research. The chapter also presented reflective activities, observations, and semi-structured interviews as data-generation tools of this study. Being a pragmatic action research, the study applied data generated in two phases of reflective activities: one phase of observation and one phase of one-on-one semi-structured interviews. Interviews were with six Grade 3 teachers, who were purposively sampled to take part in this study. The teachers' identities and names are not used in this study; instead, they are represented as Participants 1 (P1) to 6 (P6). The words Participant 1 to Participant 6, P1 to P6 or teachers will be used interchangeably in this chapter referring to the population of this study. These participants are from five different schools in the KwaMhlanga South-West Circuit, Nkangala District in Mpumalanga Province.

In this chapter, data drawn from reflective activities and observations are presented and analysed to answer the first research question. Questions on teachers' understanding were directly linked to the themes of the natural identity framework which are aligned with the professional, societal, and personal identities. These are presented in the study as either expert, common, or individual understanding. As a researcher, I believe that people understand in a particular way, and how this is achieved comes by way of their individual identities. Therefore, identities inform or have an influence on what, how, and why people behave in certain ways. The reflective activity is presented as a written activity in which participants write answers to the 'what' questions provided to them. Participants write about their practice in a reflective manner (Milam, 2008). Observations are answering the operational 'how' questions and the interviews are answering the philosophical 'why' questions. This table depicts the data to be presented from each theme of the framework.

Table 6.1: Data Presentation and Analysis

What are Grade3 teachers' understandings of the implemented mathematics curriculum?		
Professional Identity for Expert Understanding	**Societal Identity for Common Understanding**	**Personal Identity for Individual Understanding**
Reflective Activities and Observations		
Objectives	Learner-centred teaching and learning activities	Goals
Specialised content	Online learning environment	Teacher as researcher
		Learners
Teachers as experts	Assessment for learning	Blended learning environment
Summative assessment		Peer assessment
Why do teachers have a particular understanding of the implemented mathematics CAPS?		
Reflect		
Critique		

6.2. Findings and Discussions from Themes and Categories of the NIF

The first research question is: 'What are the teachers' understandings of the implemented mathematics curriculum?' In answering the descriptive 'what' question, teachers' responses bore evidence of whether they are aligned with the expert, common, or individual understanding. Questions on teachers' understanding are directly linked to themes of the NIF and the curriculum concepts. These concepts are rationale, content, teaching and learning activities, roles, resources, teaching and learning environment, and learners and assessment. The NIF themes are identified as professional, societal, and personal identities. Firstly, for expert understanding, questions were asked in relation to participants' understanding of *objectives, specialised content, expert teachers, and summative assessment.* Then, for common understanding, teachers answered questions related to *learner-centred teaching and learning activities*, *online learning environment* and *assessment for learning*. Lastly, for individual understanding, participants' responses, where analysed: the focus was on *aims, teacher's role as a researcher, blended learning environment, learners, and peer assessment.*

Validation of 'what' teachers understand was sourced from the reflective activities; and 'how' they understand was interrogated through observations of their actual practice, which is teaching, in a classroom setting. Both the reflective activities and observations led to identifying some elements of personal identity and individual understanding: some of the participants projected both expert and common understanding.

For reflective activities, each participant's account of their understanding was captured in two phases. The purpose was to evaluate the possibility that they would maintain the same level of understanding, through the professional, societal, and personal identities in the first and second

phases of the written reflections. The observations reflected how teachers understand the curriculum, using the NIF themes to explore teachers' expert, common and individual understanding.

6.2.1. Goals

Goals are outcomes of a series of successfully achieved objectives. Setting of goals by teachers should be in the context of their practice (Bergh &; Betti, 2020). Goals are not tailor-made for each teacher to achieve; they are intentions that teachers have for themselves in relation to their practice. Goals are achieved through a teaching and learning process that teachers embark on (Khoza & Biyela, 2020; Anderson, 2020). Goals are identified in this study as aims (individual understanding), objectives (expert understanding) and outcomes (common understanding). When asked this question, it was expected that teachers would reflect on either of the three, focusing on curriculum and on mathematics as a subject. This suggested that teachers were supposed to indicate their understanding of what they needed to achieve when teaching Grade 3 mathematics.

In Phase One, based on the way in which participants reflected, findings are that teachers reflected on either objectives, outcomes, or aims and sometimes on both. The following responses were presented as their understanding of what they needed to achieve. The reflections were categorised based on their understanding of goals as objectives, outcomes, or aims.

6.2.1.1. Objectives (expert understanding) or specific aims

Mabuza (2018) and Khoza (2020) explicated that objectives are short-term goals that originate from the overall aims of curriculum; and are developed based on what the teacher intends to achieve more than what the learners have to achieve. In the Foundation Phase Mathematics CAPS, objectives of mathematics have been identified as:

> "To develop critical awareness of how mathematical relationships are used in social, environmental, cultural and economic relations; confidence and competence to deal with any mathematical situation without being hindered by a fear of Mathematics; a spirit of curiosity and a love of Mathematics; appreciation for the beauty and elegance of Mathematics; recognition that Mathematics as a creative part of human activity; deep conceptual understanding in order to make sense of Mathematics; and acquisition of specific knowledge and skills necessary for the application of Mathematics to physical, social and mathematical problems, the study of related subject matter (e.g. other subjects); and further study in Mathematics" (DBE, 2011a, p. 8).

For P3, her goal is "*To encourage and promote their (learners) learning in mathematics"*

P5's goals are *"to see learners progress and grow… their understanding of different concepts of mathematics".*

Both P3 and P4 are specific in indicating that their objectives are to ensure that learners learn mathematics, and that learners also understand the concepts of mathematics.

6.2.1.2. Outcomes (common understanding) are also identified as specific skills in the mathematics CAPS, which means that these are what learners should be able to do. Outcomes from the CAPS that have been identified are linked to Participants 2 and 4's responses that "learners should be able to use the language of mathematics, to develop number vocabulary, number concept, calculation and application skills, and to learn to listen, communicate, think, reason logically, and apply the mathematical knowledge gained" (DBE, 2011a, p. 9).

P2 alluded to her goal of ensuring that learners are able to work with numbers, which includes counting, being able to calculate using the four basic operations. P2 also wanted to make sure that learners are able to read, comprehend, and solve word problems.

P4 wrote that her goal is *"to enable learners to count, measure and to achieve all of the content areas".*

These accounts indicate that P2 and P4 understand the goals of teaching mathematics from the common understanding, as they both focused on outcomes of their mathematics teaching.

6.2.1.3. Aims (individual understanding)

P1: "*to enhance learners' lifelong learning abilities... So that learners can be able to understand mathematical language."*

P6's goal is "…*to help children to decide what they want to do in the future."*

At the end of the second phase of data collection, four participants understood aims to be more important. Participants indicated that they are preparing learners for the future and enhancing their lifelong learning. This includes advancing their careers in mathematics and being able to use what they have learnt in other spheres of life as adults. Their understanding was aligned more with their knowing that there are general curricular aims as stipulated in the overview of the national curriculum in the mathematics CAPS document (DBE, 2011a). Of concern is whether teachers understand that the general aims of the curriculum serve as pillars for each objective and content for each subject. Regarding objectives, two participants consistently focused their

understanding more on objectives aligned with the expert understanding and performance curriculum.

In Phase Two reflections, on the one hand, P1's goal is to ensure that learners acquire the mathematical knowledge that will help them to excel in other subjects. The same sentiments are held by P2 who alluded to her understanding of her goal being to make learners aware that *"life is lived through a series of systems that require time and calculation for successful outcomes."* P4, P5 and P6 also added that their goal is to advance learners towards acquiring problem-solving techniques that they will use later in various industries. Teachers are also preparing learners for the 4th Industrial Revolution. Shifting from the understanding of setting only lesson objectives, teachers focused on the long-term aims that will benefit learners. This understanding is aligned with their individual understanding and personal identities; and bears evidence that these participants have reconciled the expert with the common understanding.
Contrary to other participants, P3 still maintains that she applies her professional identity. P3 indicated that her goal is *"to make my learners improve and understand calculations."* An understanding of calculations in mathematics is an objective of the mathematics curriculum; therefore, this is an expert understanding of goals.

To sum up the findings**,** it was revealed that participants did not intimate their desired outcomes during reflective activities, focusing instead more on aims and objectives. According to Mabuza (2018), learning outcomes clearly state identified content and specified skills to be acquired; such are society-centred and promote societal identities. Khoza (2021b) and Mabuza (2018) explained that when learning outcomes of each subject are specified, it reflects the plan for teaching and learning is carried out and how teaching and learning operations were expected to manifest. Therefore, to promote achievement of learning outcomes, teachers should follow a competence-based curriculum. This may be the reason for teachers not making mention of learning outcomes; the mathematics CAPS is a performance-based, content-centred curriculum relying on curriculum aims and subject objectives.

Khoza (2021b) maintains that to drive performance curriculum academics set objectives as short-term goals to subdivide the prescribed content. Mistree *et.al.,* (2014) posits that learning objectives are generic skills that must be accomplished and are expressed in terms of the six levels of learning defined in Bloom's taxonomy. Bloom's taxonomy is found to be effective in determining the learning objectives as it provides clear guidelines and tasks that are learning

orientated. The University of Technology Sydney (undated) and James (undated) add that objectives are concrete; and they outline what students are expected to learn and be able to do in a particular subject at the end of the lesson, year, or phase. Furthermore, "objectives deal with the cognitive, affective, and (sometimes) psychomotor domains" (Ornstein & Hunkins, 2018, p. 216) of learning. The sequence of the objectives is linked to the sequence of the selected content. Lunenburg (2011) and Ornstein and Hunkins (2018) maintain that objectives are important, being consciously willed goals. Such goals become criteria of which content is coherently selected, organised and outlined, resources are selected, instructional procedures are developed, and assessments are planned and prepared (Tyler, 1949). Ornstein and Hunkins (2018) add that sequencing of objectives, moreover, being connected to the content, are also linked to learning activities.

Khoza (2013) argues that a teacher-centred approach (behaviourism) is an effective approach for presentation of objectives. Therefore, an understanding that subjects are having their specialised content that is coherent, with clearly stated overall aims is evidence enough that objectives are in the expert continuum of curriculum; hence in the findings, the participants continuously referred to mastery of mathematics specific skills. Mabuza (2018) explains that objectives are short-term goals that emanate from aims and signifies what teachers need to do towards achieving the aims of curriculum. Objectives are an important component of a performance curriculum because, through objectives, curriculum developers or policy makers are able to gauge whether the curriculum has met its goals and aims. Marsh (2009), in his book, *Key Concepts for Understanding the Curriculum*, points out that objectives play an important role in the planning process for teachers, and provide answers to what learners learn and what teachers have to teach. Furthermore, Marsh (2009) maintains that objectives are likely to lead to improved learner performance because they help both the teacher and the learner to focus on what will be assessed. Therefore, the teachers' ability to select objectives is evidence of their alignment with expert understanding.

To meet the desired objectives, teachers ensure that learners are aware of what is expected of them; because achievement is dependent on clearly stated objectives that are measurable (Adagale, 2015 & van den Akker *et al.*, 2009). Clearly stated objectives, according to Tyler (1949), have two dimensions, which are behaviour and content. For this reason, objectives can be stated in such a way that they identify both the kind of behaviour to be developed in the learner; and the content in which this behaviour is to operate, e.g., in Grade 3 Mathematics CAPS (DBE, 2011a, p. 75) "learners are expected to: solve (behaviour) money problems involving

totals and change in rands or cents (content)". However, findings reveal that although teachers had set objectives, they did not communicate these to learners before the lesson started. This becomes a challenge and creates a gap in terms of teachers' understanding: what they say and what they practice running as parallels. The findings are therefore consistent with literature in that, when one examines all these models, it is evident that the teacher is in control. Content is prescribed because teachers do ensure that the selected objectives match with the content to be taught; and through assessment teachers determine whether these objectives have been met.

The gap, however, as found in Khoza's (2021a) study, aimed at exploring and understanding teachers' identities in teaching mathematics in the 4IR. Teachers still find it difficult to differentiate between aims, objectives and outcomes; although objectives are clearly specified in the foundation phase CAPS mathematics document. This finding is consistent with the findings of Galane's (2016) study aimed at exploring subject advisors' reflections on the supervision of Grade 3 mathematics CAPS implementation. The study found that "subject advisors are aware of the aims of the CAPS, and also the aims and objectives of the foundation phase mathematics curriculum. However, subject advisors could not classify objectives and outcomes correctly" (Galane 2016, p. 139).

For this study, findings are that when teachers plan and prepare lessons, they understand that they have to clearly specify objectives. However, consistent with Khoza's (2021) findings, because the curriculum is being converted to the digitalised curriculum in HEI and is being trimmed in the school system, challenges have emerged which obliged the academics also to transform; in this case the objectives were also reduced. The reason is that the setting of objectives is dependent on how much content is taught and the accessibility of that content to students. In his study, Khoza (2020) found that academics had to set fewer objectives because many students had limited access to Moodle or resources for online and remote learning. It has been stressed in literature that this barrier occurred because many students live in rural areas where there is either no or poor connectivity; other students do not have devices. Along the same lines, Nhlongo (2020) argues that, because institutions teach a diverse population of students from diverse contexts, it is difficult to teach using technology when learners have limited access to such. Similarly, in the teaching of mathematics in Grade 3, teachers also had to be cautious in setting goals and maintaining the set objectives. The curriculum had been trimmed; and learners had to learn remotely owing to the nationwide lockdown. An oversight when curriculum was trimmed was that objectives of the curriculum were not altered in line with the trimmed content. The trimming of the curriculum saw many topics and concepts not being included in content that

was deemed critical to be taught. The implication, therefore, is that the already struggling teachers are more confused as to how to state the objectives and align them with the trimmed specialised curriculum content when they teach.

6.2.2. Content

Content, as defined by researchers, is subject matter knowledge, skills, dispositions, understanding and values that constitute a curriculum; and may be presented in many forms, including audio, text, and video (Berkvens *et al.,* 2014; Wood & Hedges, 2016; Mabuza, 2018).

All participants, except for P2, when asked the content they are teaching mentioned content that is from the mathematics CAPS document for the foundation phase. The content areas are numbers, operations and relationships; patterns, functions and algebra; space and shapes; measurement and data handling.

Although teachers knew what content areas to teach, they could not say exactly the order, as arranged in CAPS. Some mixed the content areas with concepts and skills that must be taught.

For example, P1, when asked about her understanding of content, said: *"... numbers and operations, Space and Shapes, Measurement and Data Handling, concrete objects, role play, fractions (practical activities given), using language of Measurement e.g. greetings in the morning."*

Firstly, the content area mentioned is numbers; operations are numbers, operations, and relationships. In this case, the teacher omitted the relationships part of the content area. It is not clear whether she omitted this deliberately or whether it was an oversight or whether she is unaware of this. Secondly, P1 continued to mention concrete objects. In mathematics concrete objects are not content but are resources that learners use to help them count or make calculations. Concrete objects help to support the teaching of other concepts, such as measuring capacity or mass. Role-play also is not part of content that must be taught. Lastly, P1 indicated that they use the language of measurement, for instance, when they greet in the morning. The language of mathematics is used across the teaching of mathematics content but cannot be classified as content.

P5, when reflecting: *"MOR, patterns and algebra, Space and Shapes, Measurement, and Data Handling."*

The assumption here is that he wanted to say NOR which is widely used to abbreviate the content area numbers, operation and relationships. Space and shapes and data handling were correctly mentioned. P5 made no mention of teaching measurement. With patterns P5 also said patterns and algebra. In this case he omitted to mention all the functions which complete the content area patterns, functions, and algebra.

P3 explained that she teaches *"Data Handling, Measurement, counting, mental maths, and number operators. Every content is important and needs to be taught."*

Although P3 mentioned only two content areas, she included counting and mental maths. Her understanding of what needs to be taught is based on what she finds in the CAPS documents.

Similarly, P4 asserts that she teaches *"number, patterns and Data Handling."* Similarly, with other participants, she is guided by CAPS in terms of what needs to be taught.

P6, when reflecting on this question, wrote that *"Number operations and relationships, Patterns, Functions and Algebra, Space and Shapes, Measurement, and Data Handling. The content is received from the CAPS document from the government."*

P6 acknowledges and understands that content is prescribed by government and is packaged in the CAPS document for mathematics. For him, his source of reference as what to teach is the curriculum document without deviation.

P2: *"We have mathematical vocabulary, learners should be able to understand, word sums, learners need to be able to read with understanding, they should be able to read word problems in the blue book."*

For P2, content is mathematical vocabulary and word sums. The reasons are that learners' competence in solving problems is associated with their ability to read. P2 also mentions that learners should be able to read from the blue book. In this context, the blue book is the Department of Basic Education's workbook given to schools as a resource to be used to consolidate concepts taught, either as formative or summative assessments.

In Phase 2 reflections, there are slight changes in other participants' understanding of content to be taught.

For example, P5 took a turn from the previous reflection as in this phase he indicated that he teaches *"Basic counting, 4 basic operations, Measurement, Number Patterns and Algebra and Data Handling."* In the first reflection, P5 mentioned the content areas of mathematics; and in

Phase 2 reflective activity P5 mentioned specific topics from certain content areas, leaving other content areas as they are.

All the other participants in terms of understanding content they need to teach, maintained what they reflected on in the first phase. However, some participants made some additions.

For example, P2 added, *"Problem solving skills starting with concrete, going onto representational and leading the learners onto abstract"*

In this account P2 provides strategies on problem solving, adding to learners' ability to read as a strong foundation for problem solving.

P3 also maintained that content is developing learners' mental maths skills. *"Basic mental maths skills such as bonds, building up, decomposition of numbers, understanding the cardinal value of numbers, grouping and sharing leading onto multiplication and division, understanding money, analogue digital time etc- which all falls within your NOR, Patterns, space & shape, Data Handling & Measurement."*

In this reflection, P3 provided more insights by mentioning topics and concepts from the content areas, with greater reference to numbers, operations, and relationships.

P5 took a different turn from the previous reflection, now reflecting that he teaches *"Basic counting, 4 basic operations, Measurement, number patterns and Algebra and Data Handling."*

P4 and P6 maintained what they reflected on from Phase 1, that they teach content from the CAPS document.

The findings on participants' understanding of content they teach, reveal that participants have various levels of understanding of the content that must be taught. When making reference to what needs to be taught, however, some did not enter their reflections. It is evident that they understand content to be taught as the standardised content in the mathematics CAPS, but have limited understanding of its content-centred nature aligned with the performance curriculum. For example, two participants' understanding of mathematics content, adding to the content areas, was found to be the use of concrete objects, role playing and reading with understanding, respectively. This is supported by literature findings that, based on the teachers' varying levels of knowledge, their understanding of subjects may differ and even influence how they teach. Each teacher has own beliefs, identities, and unique ways of interpreting mathematics. Actions are informed by the knowledge teachers bring to their practice (Güneş & Baki, 2012; Carpenter, Fennema & Franke, 1996, Moru *et.al.,* 2014).

It should be noted that within each content area there are topics. Each topic has concepts and skills that are grade appropriate, with progression each term per grade. Although it was evident from the findings that the majority of participants are aligned with expert understanding, maintaining their professional identities, participants barely reflected on this to support their expert understanding of mathematics content.

This content is specialised because all teachers who are implementing the CAPS mathematics in South Africa are supposed to teach it as it is, without deviation. This further suggests that CAPS is content-centred and aligned with the expert understanding of the curriculum and with behaviourism. Teachers who support behaviourism (content-centred) want their learners to master the content and to achieve high marks, which will position them as top achievers (Khoza, 2021b). These teachers are obliged to be performance-driven and to have sound content knowledge and understanding to operate as experts.

6.2.3. Teacher role

As discussed in the literature chapter, roles of teachers are fluid and are also informed by whether they are aligned with expert (expert teachers), common (facilitator) or individual (researcher) understanding of the curriculum. Furthermore, teachers can be transmitters of knowledge in the teaching and learning process; or facilitators in the learning process. In performance curriculum, teachers are expected to play the roles of experts when teaching. In competence curriculum teachers have to play the role of a facilitator. Some teachers, when teaching, combine their roles as experts and facilitators and they become researchers more than teachers. Participants' understanding of their roles differed when answering the question on reflecting. In this question, the simple term that can be used for one's role is what they do in their job. Roles are generally prescribed in relation to the profession; however, each individual may have a personal understanding of their roles in the same profession, influenced by what a role is.

When reflecting on what participants understand to be their roles in Phase 1, P1 expressed that her role was to "*make sure that learners develop the love of mathematics… give them an opportunity to work as individuals and in a group."*

P2: *"I should lead by example and enjoy what I teach because learners can sense when you don't like the subject."*

P3 viewed her role as *"to …assist and be available for learners. To make sure that they understand what is being taught."*

P1, P2, and P3 seem to understand their roles as caregivers more than teachers. They understand that their role is to make learners feel that they belong. Statements such as 'make them enjoy, develop love, assist, be available' show that teachers understand their roles as being compassionate, playing the pastoral roles over and above being teachers. What is also revealed is that their role is to support learners who find barriers to learning. This is mentioned by P2, P4, and P6. P4 further mentioned that her role is to teach the learners. She is the only one among the participants who mentioned teaching as her primary role of being an expert teacher. P6 instead mentioned his role as that of an assessor; and while at it, he will be observing, which leads him to improving his strategies. He is not explicit about his teaching role, but alludes to his assessments being formative to improve his practice.

In Phase 2, understanding of roles moved from passion to support for most participants.

P1: *"My role is to impart sound knowledge…to teach aspects in a manner that's not mundane."*

P6 now understands his role *as "teaching and learning, assessment, support, recording and reporting."*

P6 is consistent with what he understands to be his role, adding the teaching and support. Expert teachers are required by policy to assess and report to stakeholders in education on learner performance. What stood out is the 'learning' role. Contextualising this understanding, P6 may be meaning that his role is also to learn to be a better teacher. In this case P6 also assumes a researcher role. As a learner, he is aligned with his personal identity and individual understanding.

P2, P4, and P5 added that they understand their roles as being to monitor and guide learners to use what they already know to help them with problem-solving. In this account, these participants understood their roles as those of facilitators of learning, because they monitor and guide. They give learners opportunities to work on their own. Teachers observe as the learners work and solve problems, then guide where support is needed. This aligns with the understanding of their roles in the competence curriculum, making it a common understanding of their roles as teachers.

P5 understands his role as *"to help learners love and enjoy math so that they can better themselves in the future."* P5 also has a common understanding of his role. This is aligned with

his societal identity because he needs to make sure that his learners are contented and are enjoying the subject.

For P4 teaching learners is still her main priority. Adding to what she reflected on in Phase 2, she states *"... I also have to report to their parents and explain how they are doing and ask them to help me."* Therefore, P4 and P6 hold high the obligation to report to parents on their children's educational progress.

In the second phase of reflections, teachers have understood their roles as also being teachers, imparting knowledge to develop learners' cognitive skills/abilities, which is aligned with the expert understanding. Teachers also included an aspect of parental involvement. Some participants understand that after teaching learners, they have to report to parents on progress or non-progress of their children. This supports collaboration of stakeholders, which is a social activity aligned with common understanding. Participants' understanding of their roles, based on their reflections in Phase 1 and Phase 2, is fluid. In one instance they are professionals; in another they are community assets, playing pastoral roles, being compassionate, and providing help. They are also individuals, driven by passion and the love of mathematics, wanting to instil that love in the learners they teach. In this account, they also bring about their individual understanding.

6.2.4. Assessment

Assessment should be regarded as the heartbeat of any curriculum innovation. At school level, especially in the foundation phase, both formal (assessment of learning) and informal (assessment for learning) assessments are set at school level. Teachers have the responsibility of ensuring that they set school assessment tasks that are quality to ensure that what has been taught has been covered. Furthermore, these assessments should be set in such a way that the core skills for the subject are assessed. To answer the 'what' questions of assessment, teachers must have a clear grounding of both summative and formative assessments, these being both important in their own way. Summative assessment is used to grade and promote learners to the next grade, whereas formative assessment is used to assess what has been learnt, improving it if there are gaps. It is the assessment that determines whether learning has taken place and whether the curriculum is meeting its objectives. When teachers reflected on their understanding of assessment in mathematics, they had differing understandings.

In Phase 1 participants' understanding of assessment are almost identical in that they all know that there are formal (summative) and informal (formative) assessments. These are the prescripts of CAPS with regard to assessment. Some participants deliberated on the difference between formal and informal assessment. They mentioned that informal assessments are daily; and formal assessments are made once a term and developed using an assessment framework.

P1 reflecting on her understanding of assessment, described assessment as *"…both formal and informal. Formal is from the CAPS and informal is classwork, homework and DBE book."*

P1's account indicates that she understands that assessments are administered at both summative and formative assessment levels; and that this is a requirement of the curriculum.

P2: *"There are formal assessments and learners write them. Every week there is a test to check if they understood what was taught. I also assess them in class by giving them more work."*

Similarly, P2 understands that there are formal (summative) assessments that must be administered. However, her understanding and interpretation of summative assessment are written tests.

P4 makes mention of continuous assessment. Administration of continuous assessment is aligned with the competence curriculum; however, in the revised Chapter 4 of CAPS for foundation phase (DBE, 2019), it is indicated that continuous assessment should be conducted in the foundation phase to avoid heavy reliance on formal, summative assessments.

In Phase 2 of reflections, P1 added that the questions they set in a task are aligned with Bloom's taxonomy. P2 maintained that she gives them writing tasks. Her focus is on writing, which is aligned with behaviourism, because, according to her, learners are taught, tested, and then either pass or fail. Written tasks are summative in nature and are given to cover the cognitive levels, according to Bloom's taxonomy.

P3 brought forth a different dimension in her reflection that *"there are oral assessments and classwork. Formal are written using a test and a framework."* In this reflection, P3 understands that there are forms of assessments prescribed to be used to formally assess learners, which is her expert understanding. She also understands that she has to administer formative assessment, using classwork, during teaching and learning, which is her common understanding of assessment. Holding the same sentiments are P4 and P6 who both bring forth the issue that in the foundation phase assessment is both formal and informal.

P5: *"…formal assessment is once a term because of CAPS and informal I assess every day after teaching."*

"I assess by giving them classwork, worksheets and homework because they are not formal. For formal task I use a framework to set a test," wrote P6.

In Phase 2 reflections, participants gained the opportunity of re-reflecting on their understanding of assessment. P1 added that *"…questions are aligned to Bloom's taxonomy. Data is regularly analysed checking for shortfalls. The termly stats (formal tasks) are closely monitored"* In this account, P1 now added the expert dimension of assessment, which is the use of Bloom's taxonomy. The curriculum recommends that when setting formal assessments, teachers must align the tasks with Bloom's taxonomy so that all learners are accommodated by the tasks. Again, P1 indicated that these tasks are quality assured before they are being administered. The performance statistics are monitored at the end of each term. P1 and P5 also understand that each term learner performance is analysed to identify gaps and provide improvement strategies for the subject. This is a norm; and schools have to comply. In schools this responsibility is vested in the departmental heads in a phase or a subject; thereafter, at the end of the term, they submit the performance statistics to the district officials for quality assurance checks, evaluating the compliance with the assessment processes for each subject. Summative assessments are quality assured for covering all content required for the term. P6 extended his understanding of assessment by indicating that assessments are not only written − they can also be practical and different assessment tools to be used during assessment.

P4 and P5's reflection on their understanding of assessment is that assessment is administered continuously throughout the term. This position is for teachers who are aligned with the common understanding on societal identities, continuous assessment being the strength of competence curriculum. These participants understand that the learners' competences for the whole term should be considered for their performance and promotion.

In both phases of reflections, it may be concluded that teachers' understanding of assessment is that it is a process in accountability. One must be guided by the curriculum when assessing learners.

Findings from reflective activities in both phases reveal that teachers understand assessment as both formal and informal. This contradicts Dayal and Lingam's (2015) study findings that teachers' understanding of assessment is mostly based on summative uses of assessment. Teachers in this study are aware that informal assessment is to support learners and improve their

teaching if there are concepts not properly learnt. Formal assessments are written tasks that are recorded for promotion purposes. Their position regarding the informal assessments, which are also called formative assessment or assessment for learning is consistent with findings from literature that formative assessment is mostly used as part of a learning process to gather learners' information. Such improves pedagogy, and improves learner performance but is also a diagnostic tool to assess the level of learners' knowledge showing where teachers have to start teaching (William, 1999; Harlen and James, 2005, Ojuko *et.al*, 2013; Nortvedt, *et.al*, 2016; Rummanova *et.al.*, 2020). Furthermore, formative assessment, according to Cheong (2017), is a self-assessment tool which teachers do not know about, therefore need capacitation in this regard.

Regarding summative assessment, findings are that teachers correctly interpret them as formal; and that they are quality assured by district subject advisors as covering all assigned content for the term. It was also found that teachers understand administration of assessment as compliance rather than as a developmental process: this is because they have to report to stakeholders, make diagnostic analysis and account for learner performance. Dayal and Lingam (2015) support the decision of making summative assessments as a reporting criterion to stakeholders. These researchers believe that this gives stakeholders in education a clear picture of whether teaching and learning has taken place.

When reflecting on their roles as administrators of assessments, some participants' reflections were that their role is to support learners with barriers to learning. However, when reflecting on assessment in both phases, there is no mention of differentiated or adapted assessment tasks. Teachers therefore understand the importance of using differentiated assessments; however, they lack capacity to do so. This is also evident in the way in which they teach.

6.2.5. Teaching and learning activities

According to Mabuza (2018), teaching and learning activities are organised lessons planned and prepared by the teacher with the purpose of enhancing the knowledge of learners. Content becomes more meaningful in learning activities that learners experience in both formal and informal settings or contexts (Berkvens *et al.*, 2014), because learning takes place when a learner interacts with the environment (Galane & Khoza, 2023; Khoza, 2014; Schiro, 2008).

This question required participants to reflect on teaching and learning activities, their understanding of how they teach, and the type of learning activities they are exposing learners

to. When teaching mathematics, Participants 1, 3, and 4 averred that effective teaching occurs when they practise whole-class teaching.

P1: *"Teaching them through whole class teaching… I am able to identify slow learners… to accommodate all the learners and identify those who are not doing well in particular content areas."*

P3: *"I start by teaching the whole class, then teach them individually. Stopped group teaching since covid. Stopped teaching small group since Covid as the time was limited. Small group teaching was good, the number of learners create efficiency. The lesser the group, the more they respond."*

According to P3, Covid-19 disorganised how she used to teach her learners. She displays societal identity, using common understanding by indicating that she has been using learner- centred teaching approaches to teaching. Her circumstances forced her to follow content-driven and teacher-centred approaches which are for expert understanding. P3 uses professional identity in teaching. P3 embarks on whole-class teaching because she feels pressed for time. Of note also is that P3 states that she offers individual teaching, but does not indicate when and how this happens.

P4 also understands that effective teaching takes place when she teaches the whole class. *P4: "When explaining a concept, I explain to the whole class. In order for me to determine whether they understand me, I tell them to do what I am explaining on the chalkboard so that I can know if they understand me or not."* P4's understanding of teaching and learning activities portrays her expert understanding and professional identity. This is consistent with P4's reflection on her role as a teacher. Expert teachers assume expert roles, which is to teach the whole class, teaching and learning being predominantly teacher-centred. This position encourages rote learning, with a belief that all learners learn same content in the same way, at the same time.

P5 did not respond to this question; however, P6: *"when I teach mathematics, I incorporate multiple intelligences. I also identify if my learners are visual or kinaesthetic learners."* P5 thus uses his expert understanding of how he should teach the learners. He uses school knowledge in applying an educational theory to teach his learners, with an understanding that each learner learns differently. This understanding is in line with the CAPS principle of inclusivity.

In Phase 2 teachers re-reflected on their understanding of teaching and learning activities. For P1, her understanding is that policy prescribes that teachers engage small and whole-class

teaching. However, P1 maintains that when she teaches, she uses whole-class teaching. The main reason for this is that P1 has an overcrowded classroom. This, according to her, makes it difficult for her to teach small groups. Instead, P1 prefers the rotation model that resulted from COVID-19. P1 believes that rotational teaching is the best option for her learners; this teaching style has optimised her teaching. P1: *"Whole class teaching works for me as I don't have a choice. My class is overcrowded. CAPS wants group teaching but is not possible in my class. Rotation was better because we were teaching a smaller number of learners."*

P2 and P6 both reflected that they use differentiated and ability groups; they believe that it is important to teach learners according to their abilities. Both P2 and P6 are aligned with the competence curriculum; they believed that using a learner-centred approach is the best way of teaching learners. Their societal identities and common understanding come into play. P2: *"You can also make use of fluid groups in order to provide remediation."* P5: *"encouraging the use of repetitive examples to allow for practice and application of skills."* In this account, P5's use of repetition and practice promotes learner-centred teaching and learning. P5 gives learners the opportunity to practise and apply skills acquired in the lesson to solve those mathematical problems. This is his personal identity aligned with his individual understanding: this is what works for him and his learners. Teaching in this way, for him, yields positive results. A similar practice is manifested in P4's reflection. P4: *"I count out loud with my learners. I do practical with them, e.g., counting objects. We add, subtract, multiply and divide numbers."* According to P4's understanding, teaching and learning is a shared exercise. This makes her classroom a learner-centred classroom. P4 makes use of a strategy that she believes works for her learners. This is P4's personal understanding because she is neither doing it according to expert nor common understanding: she is doing what works for her and her learners.

The findings in this question reveal that, even when teachers re-reflected, their understandings in some instances remain unchanged, not because they do not want to transform, but because the circumstances in which they operate compel them to follow a particular way of teaching. This is evident in P1's reflections, despite understanding how she has to teach and what works for her and her learners. Overcrowding, which is beyond her control, forces her to use teacher-centred approaches. This is a contextual factor beyond the teacher's control and it has an impact on her teaching, not for her only but also for other teachers. This, in turn, may affect how teachers understand their roles, as discussed earlier.

6.2.6. Understanding the learners they teach

In Phase 1, on this question, participants reflected that they are teaching learners from different backgrounds. What is also evident is that, despite their backgrounds, these learners are still able to access basic education. An understanding of learners they teach is noted in the teachers' reflections.

P1, P4, P5 and P6's reflections of who they are teaching are similar in many ways.

P1's understanding of learners she teaches is that *"…learners who are staying at poverty stricken community, negligence by parents. Some parents work far from home. Some of the children are orphans."*

P4: *"… learners who come from challenging backgrounds where parents don't take education seriously, they do not help children with their homework. The learners are living in villages where poverty is high, and some parents are distant from their learners' school affairs."*

For P5: *"…most of the learners I teach live in poverty. You see mostly during break that they depend on the feeding scheme for their daily meals. Some ask for some more to take home and eat it in the evening. Other children bring their own food because their parents are working."*

P6: *"The learners I teach are inclusive learners whose parents are not well involved in the children school matters. Most parents don't attend the parents meeting. Some learners come to school dirty which indicates a tough background from home."*

According to the four participants, what they have in common about who they are teaching is that learners come from disadvantaged socio-economic backgrounds in which poverty is the order of the day. Secondly, parental involvement is next to non-existent; parents do not take seriously the affairs of their children's schooling. Another factor is that most learners are orphans. This may mean that they live with grandparents or in child-headed households.

For P3 their reflections are slightly different; however, some factors overlap with the first four participants' reflections.

P3: *"… coming from different backgrounds. Some learners come from families that have better understanding with school things and some are from families that do not. The homework of learners from good backgrounds differs from the other that comes from families that don't have an understanding. Some parents are unemployed, and some are employed."*

For P3, not all learners in her class are from disadvantaged backgrounds. Some are better off than others, and this is reflected in their work, as indicated above. Unemployment has also come to the fore as a challenge. This supports the previous reflections in that, when parents are unemployed, poverty is and will be the main challenge when it comes to the learners' well-being. Learners will struggle to have balanced meals and to look tidy, as P6 indicated.

From another perspective, P2 indicated that *"learners are from middle class. Most of them… have parents who are connected and they have gadgets like laptops and cell phones. The learners like books and getting homework."* For P2, it would seem that her learners are not struggling because they have working parents who can afford and have access to electronic devices to support their children's learning.

Based on all the reflections, it is only P2 whose learners have parents who fully support and can afford the education of their learners. For P3, some parents are supportive of their children's schoolwork and activities. For all other participants, the highlight is on learners' poor socio-economic backgrounds. Unemployment is also rife in their school communities. This is evident in that learners arrive at school hungry, and not being properly bathed. Lack of parental support is also of concern in that parents do not help their children with schoolwork and do not attend meetings. Participants also assume that parents' lack of interest in their children's educational affairs may arise from their not being educated themselves. What also emerged is that some of those learners have parents who work far from home; the learners may even be orphaned. These learners have to live with their grandparents; or they may be in child-headed households in which the environment is not conducive to education. For example, grandparents are sometimes too old to attend meetings or to help their grandchildren with homework. The other factor mentioned is that some children are from child-headed households, where children live alone. The implication is that each child must see to himself. Learners are all attending school and have the same challenges that do not allow them to help one another. Again, because they are minors, they are not allowed to attend school meetings; they cannot be part of decision-making in schools.

In Phase 2, participants maintained what they had said in Phase 1, making certain additions as they were re-reflecting.

P5: *"The school also have a number of learners who have emotional, psychological and behavioural learners."* P6 also agreed on the issue of learners with barriers to learning. P2, maintaining her stance over Phase 1, still indicated that parents have devices that can help their children with projects that demand access to the internet.

Teachers therefore understand that the learners they teach are more affected by societal factors than by educational elements. However, for some it may be difficult to remedy the situation, their scope of work and powers are limited to the school environment. Beyond the borders of the school, their autonomy is limited.

6.2.7. The teaching and learning environment and resources

The learning environment may be regarded as a determinant of the kind of resources to be used during teaching and learning. Therefore, the two cannot be separated due to the introduction of the 4th and now the 5th Industrial Revolutions. However, schools are still dominated by the traditional physical classroom setting. In the higher-education institutions we have over recent years seen a migration from the real-life to digitalised or online learning environment, or a combination of the face-to-face and the online which is called the blended learning environment. In each of the learning environments, there are resources used to support the type of the environment applicable.

When reflecting on this question, all participants replied that they are teaching at school. It should be noted that schools are formal settings at which teachers have to teach according to the curriculum. Bernstein posits that schools are pedagogical social contexts. The researcher notes that these contexts are defined by power and control relations between spaces, discourses, and subjects. Schools are pedagogical and social because these are spaces in which teaching and learning, traditionally, are assumed to be taking place.

Schools, therefore, push for teachers to portray professional identities and expert understanding; there are rules to be abided by when one is in the school environment. All six participants are teaching at ordinary public primary schools. The population of learners in all 5 schools is Black African only. P1, P2, P3, P4, and P5 have the same views about what comprises teaching at a school.

P1: *"I teach at a school. Teaching at school is better than teaching at home because it is guided by policies on content that is taught*."

P2: *"Formal environments work better because it is disciplined."*

P3: *"Teaching in a school is important than at home because there are rules and regulation in place, also moral."*

P5: *"I teach at a school. School is a favourable environment to groom learners."*

These five participants all teach in schools. What they have in common is that, to some extent, they understand the school environment as a rehabilitative environment for learners. This is because there is control, there are rules, and it is a safe place. Furthermore, there are policies that regulate how schools should operate and how learners should behave.

P6 also reflected that he teaches in a formal school environment, but added that *"…it is not important. I would also like if my learners were to explore. Some might benefit from coming to school every day and some will not. If the school could provide resources, then it will be beneficial to all learners."*

According to P6's account, the school is not the be-all and end-all of education. He believes and understands that learners can still be taught and can learn outside the four walls of a classroom and outside the schoolyard. Furthermore, learners can be taught in any form of environment. P6 believes that in- and out-of-school learning may benefit a diversity of learners as this would be embracing their individuality. P6's statement also suggests that a school environment can only be beneficial, optimising learning, if it has adequate resources for this cause. In this phase, teachers made no mention of the online teaching and learning environment, but only the school as a physical learning environment.

In Phase 2, the participant reflections remained the same. However, the participants added the status of their schools. For example, P1 stated that she teaches at a government school and P4 added that she teaches in a Quintile 2 school that has easy access to the main road; it therefore hosts about 1200 learners. Based on all reflections on the learning environment, teachers are all teaching according to the prescripts of policy in a formal setting. Their common and individual understanding cannot be embraced because of the nature of the schools they are teaching at. Their identities are limited to the professional identity; these identities cannot be expanded to societal or personal identities even if teachers like P5 want to expand their horizon and explore other environmental avenues to teach his learners.

These reflections allow one to conclude that, even during the COVID-19 pandemic, when the world demanded utilisation of online teaching and learning platforms and resources, for these teachers, it was impossible to comply. It is clear that teachers could not access the digital platforms for reasons beyond their control. The system thus did not support them fully in terms of an online learning environment. Availability and accessibility of online resources was also a challenge based on the reflections below.

In Phase 1, when reflecting on resources, for example, P1, P3, P4, and P6 had similar responses when asked about their understanding of resources required to use when teaching mathematics and what they actually used.

P1: *"Bottle tops, sweet sticks (concrete objects) for counting, shapes (bring along whatever kinds of boxes to identify 2D and 3D). Due to socio-economic issues, we are far behind to use online learning because there are a lot of child-headed families, orphaned families, where children are left with grandparents who cannot use gadgets."*

P3: *"Teaching aids, money (coins and notes), shapes, time (watch or use calendars), and scales. Online resources were not used because parents were unresponsive."*

P4: *"We can use counters, real objects like bottle caps, tape measures, charts to help with counting numbers. Resources used in online learning were not used because we as teachers were not familiar with the technology."*

P6: *"I have used operators, building blocks, and play money (monopoly money). We do not have the resources to access online and it will be difficult for the learners to use online resources."*

These four participants' understanding of the mathematics resources are the use of recommended traditional concrete resources as per CAPS. All their reflections revealed that they used concrete mathematics resources. This is consistent with and in support of the learning environment that they are using. These teachers all further indicated that they did not use online resources because of lack of online resources, learners' socio-economic backgrounds, and their lack of familiarity with and skills to use the online resources.

P5 did not respond to this question. P2 reflected that the learners she is teaching are from households in which parents are working. These homes have electronic devices for access to online platforms. However, P2 did not indicate whether she uses these platforms and resources during teaching and learning. In her reflection P2 said, *"All in one integrated and the mathematical toolbox for Measurements, shapes, time, and objects."* This means that she also uses concrete resources.

In Phase 2, it was only P1 who added that she also uses YouTube videos. However, all the other participants maintained that they use concrete resources. They named the resources they were using, which include number lines, building blocks, the abacus, number grids, flash cards, inter alia. They have these resources in their mathematics resource kits. From the reflections, it is clear that teachers do not attempt to use the digital platforms and resources available on social media.

This may be because they have no online resources and no support for such. Teachers thus maintain their expert understanding of which mathematics resources to use.

6.3. Findings and Discussions from Observations Addressing the Operational *'how?'* Question.

As a data-collection tool, observations are regarded as powerful research tools. Observations give the researcher the opportunity of purposefully collecting first-hand data from naturally occurring settings (Gorman and Clayton, 2005; Koshy, 2005 Efron and Ravid, 2013; Cohen *et al.,* 2018). In this study, physical observations could not be conducted due to COVID-19 restrictions. However, teachers' lessons were video-recorded and the recordings of their lessons in action were observed.

It should be noted that, in the initial plan of the research, observations were not part of the data-generating methods. Participants were engaged regarding the change of plan from focus group to observations: they agreed to this change. The observations were chosen by the researcher to replace the focus-group interviews for two reasons. Firstly, due to the COVID-19 pandemic, the researcher was refraining from having a group of people from different environments gather in one place. Some participants' age or comorbidities could put them at risk. Comorbidities may put such people more at risk of contracting COVID-19, their immune systems already being compromised

Secondly, the choice of observations as a suitable data-generating method was that the study adopted the natural identity framework as the framework for analysis. Through this framework, teachers have to re-reflect on their actions, showcasing at the same time the 'how' part of their practice that will lead them to achieve their objective reality. Such was then achieved when they were interviewed in the second phase of data generation. During an interview the researcher has the opportunity of asking a question and probing to get to the root of reasons for people acting in a particular way. In this study interviews led participants to answer the question, "Why do teachers understand the implemented Grade 3 mathematics in a particular way?" This will be discussed in the next section of analysis.

Prior to conducting the observation, the participants were presented with two ways in which the researcher can observe their lessons. These are that the researcher makes an appointment, visits the school on an agreed date, and comes to observe the teachers teaching a mathematics lesson. Alternatively, participants plan and prepare their lessons, then ask a person or a colleague they

deem reliable to video-record them while teaching. It was agreed that teachers would video-record their lessons. The researcher would fetch the recordings from participants. Thereafter, the researcher would play the recordings, observe how teachers were teaching, before analysing the recordings. This method was also found to be convenient, reliable, and cost- effective; it saved time that would have been spent in moving around the 5 schools to observe lessons.

6.3.1. Teachers' understanding in action: observations tell a story

The main purpose of engaging in observations, as earlier stated, was to observe teachers teaching, to observe how they teach, which later translated to how they understand the implemented mathematics curriculum. The observations were meant to examine *content, teaching and learning activities, resources, accessibility, learning environment* and *assessment.* Therefore in each lesson, teachers were going to showcase *how they teach the mathematics content; how they achieve the outcomes, how they use the resources to support the teaching of mathematics; how they teach mathematics in Grade 3; how they portray their roles during teaching and learning of mathematics; how they relate with the learners they teach; how they use the teaching and learning environment;* and *how they assess what they have taught during the mathematics lesson.*

Prior to the observations, participants had to individually engage with planning of a mathematics lesson that they would teach. No structure of planning was given to them. However, there are key aspects of a lesson that teachers must focus on when planning and preparing a lesson. Those aspects are counting, mental mathematics, concept development, and consolidation. During consolidation, oral and practical problem-solving activities may be added as part of consolidating concepts learnt. It was through these observations that the researcher was able to evaluate whether 'how' they teach is informed by expert, common, or individual understanding. This section will therefore start by presenting each participant's observation; thereafter presenting the analysis per theme, thus identifying patterns and consistency between the reflective activities and observations.

The observations revealed that all participants selected content to be taught from the mathematics curriculum document. Teachers with professional identities and expert understanding follow a particular pattern of teaching a mathematics lesson, as per the prescripts. The following table provides a summary of whether teachers used their expert, common, or individual understanding when they planned and taught their lessons. P5 sent a language lesson instead of a mathematics lesson; therefore, his lesson was not used for analysis.

Table 6.2: Mathematics Lesson Requirements

Area of focus▼ Participant ↓	Counting	Mental Maths	Concept Development	Consolidation
P1	Yes	Yes	Yes	Yes
P2	Yes	No	Yes	No
P3	Yes	No	Yes	Yes
P4	Yes	Yes	Yes	Yes
P6	No	No	Yes	Yes

This table reveals that it was only P1 and P4 who followed step by step how the mathematics lesson should be planned according to the curriculum requirements. P2, P3, and P6 did not plan for the teaching of mental mathematics; and P6 went straight into content and consolidated his lesson with a DBE workbook activity. The participants all developed a particular concept in their lessons. Except for P2, they consolidated their lessons with an informal assessment activity. They seemed to plan to use their own understanding and what works for them, which is their individual understanding.

On selection of content also, teachers selected various topics and content to teach across the five content areas. For all participants, content was selected from the CAPS mathematics and it was grade appropriate. An expectation by mathematics CAPS, is that when teachers plan a lesson, they must select a content area, a topic from that content area, and concepts/ skills to be developed. Despite the mathematics CAPS being content-centred, three of the participants: P1, P3, and P6 used integration, aligned with competence curriculum, when teaching. This supported their societal identity and common understanding. They understand that, in their subject of expertise, there are priority topics. Also, there is a relationship between topics within a subject and across other subjects that learners are taught. These teachers, according to Bajtoš (2016), have specialisation and subject competences. These teachers can be identified by their ability to perceive and to react to the innovations in education.

The following information was extracted through observing and interpreting teachers' planned lessons and their actual teaching of the lesson.

Table 6.3: Concepts Covered in Each Lesson

	Content Area	Topic	Concept
P1	Measurement	Time ***Integration:*** Length	Tell a 12-hour time in half hours Use language to talk about the Comparison, e.g., long and short
P2	Numbers, Operations and Relationships	Addition and subtraction	Addition and subtraction (context free) using the strategy of building up and breaking down numbers
P3	Numbers, Operations and Relationships	Addition and subtraction ***Integration:*** Number symbols	Addition and subtraction (context free) using concrete objects Identify, recognise, and read number symbols 0 to 1 000
P4	Measurement	Mass	Informal measuring: Estimate, measure, compare, order and record mass using a balancing scale and non-standard measures, e.g., blocks, bricks
P6	Measurement ***Integration:*** Numbers, Operations and Relationships	Time Fractions	Telling the time: • Read dates on calendars • Tell a 12-hour time in quarter hours and minutes • Use and name unitary and non-unitary fractions including quarters

Despite their various levels of understanding and views, the findings of observations revealed that teachers all selected content from the mathematics curriculum document. This is in line with the requirements of the mathematics CAPS document. The content to be taught is clearly outlined in Section 3 of the policy document. It is also consistent with Khoza's (2015a) and Soini *et al.'s* (2018) findings that teachers, using their understanding and experiences in teaching the subject, coupled with years of teacher development, are able to interpret and implement the mathematics

curriculum content as specified in the curriculum documents. Specification of content in a curriculum is typical of Tyler's approach to curriculum, and Bernstein's classification of vertical knowledge. The CAPS mathematics content is what Bernstein (1987) regards as vertical, being structured, systematic, hierarchical, and using specified knowledge.

For example, P4 was teaching content from content area measurement. P4 selected the topic/concept of mass. Within that topic she was teaching learners to "estimate, measure, compare, order and record mass using a balancing scale and non-standard measures e.g. blocks, bricks, etc" DBE, 2011, p. 88). This, therefore, suggests that this content is prescribed and specialised. All teachers implementing the CAPS mathematics in South Africa are supposed to teach it as it is, without deviation. This further suggests that CAPS is content-centred and aligned with the expert understanding of the curriculum and with behaviourism. Teachers who support behaviourism (content-centred) want their learners to master the content and to achieve high marks, which will position them as top achievers (Khoza, 2021b). It may therefore be concluded that these teachers are performance-driven, and have sound content knowledge and understanding to operate as experts. However, another revelation of findings during observations is that the participants in this study barely reflected on how their knowledge of content supported their expert understanding of mathematics. For some, however, their knowledge was reflected in how they taught the selected content. Shulman (1986) describes content knowledge as organisation of knowledge in the teacher's mind. The researcher argues that to gauge how much, or the depth of teachers' knowledge, Bloom's taxonomy may be used. However, Ball *et al.* (2005) contend that the depth of teacher knowledge cannot be measured; there is no convincing evidence in research to justify that, therefore they deem it unknown.

One other distinguishing factor that Shulman (1986) and Ball *et al.* (2005) identified is that teachers must also understand that each subject has its own specialised language. In mathematics, for example, teachers must have specialised fluency of mathematical language to enable them to transfer this knowledge to learners. One of the specific skills to be developed is the language of mathematics. The findings of this study are that teachers do use correct terminology for mathematical concepts they are teaching; however, they are not consistent with the specific language they have to use when teaching. This was evident during the observation when teachers were teaching. Teachers used mother-tongue and English interchangeably. Even when they tried to control this, it was difficult because it is habitual, aligned with individual understanding. Some participants justified the act as necessary. In Grade 4, learners are taught in English; others indicated that resources that they buy from developers are in English, not in the African

Languages. This, as alluded to in the analysis, poses a challenge during formal assessments. It calls for urgent intervention from the Department of Basic Education to provide clear guidelines on the LoLT in the foundation phase. Furthermore, in-service teacher development workshops must be strengthened, with focus on mathematics content and concepts, ensuring that teachers' expertise in mathematics and mathematics teaching is improved. Resources and programmes that DBE has developed and put in place to improve teachers' content and pedagogic knowledge must be fully utilised for this purpose.

One such resource is the '*The Mathematics Teaching and Learning Framework for South Africa: Teaching Mathematics for Understanding*' (DBE, 2018). The purpose of the framework is to guide and assist South African teachers to teach mathematics in such a way that it improves learner outcomes. The framework also provides guidance in developing teachers' expertise in teaching mathematics for understanding (DBE, 2018). It is maintained in the framework that "Mathematical expertise involves both conceptual and procedural knowledge and also awareness that procedures are based on mathematical principles" (DBE, 2018, p. 16).

Teachers must be made aware that these initiatives will not only capacitate them on the content knowledge base, but will also ensure that their roles as experts in teaching mathematics at Grade 3 level warrant them experts, hence their cooperation when they are to attend such developmental training. Teachers should also be made aware that it is an understanding of these procedures and mathematical principles that equips them to set quality assessment tasks for the foundation phase learners. Furthermore, teachers will also be able to understand that how they plan their lessons, and how they teach, translates to their roles as teachers.

6.3.2. Teacher role and teaching and learning activities

Throughout their lessons, teachers played the dominant teacher role. P4 and P6 sporadically gave learners an opportunity to come to the front and practically engage in the lesson; however, learners did not initiate the activities.

P1 began her lesson with a whole-class counting activity in 10s from 10 to 100 and backwards. For mental maths the class gave addition and subtraction facts in 10s. During the activity, as learners gave correct answers, they were clapping rhythmically.

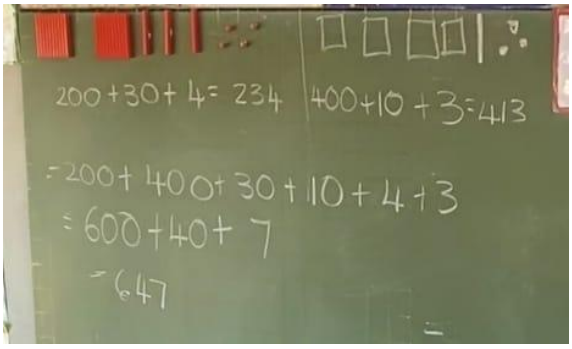
For the next step the teacher asked learners to stand up when answering questions. The learners then sang a song, "Bana ba sekolo."

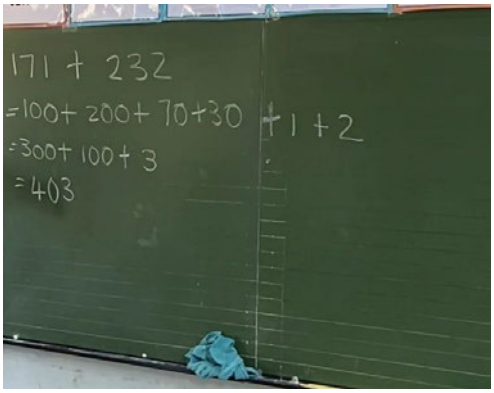
After the singing, the teacher asked learners to sit down. P1 asked what time school started. Answers provided by the learners were 8 o'clock, 7 o'clock, and 7h30 (in English). P1 corrected the learner who said 7:30 in English. P1 said "seripa-gare go tšwa go iri ya bošupa" in Sepedi, which is the LoLT in the foundation phase at their school. P1 further asked what time the break was at their school. Learners kept on providing answers in English; however, P1 corrected the learners. P1 told learners that they were going to learn about time, focusing on half hours.

Then P1 asked learners to sing the song *"Re ba ba telele, re a gola re ba ba telele, re a gola. Re ba ba kopana, re ditokološi, re b aba kopana, re ditokološi".* P1 explained that a clock has two arms: one short and one long. P1 explained that the long arm is for minutes, and the short arm is for hours. P1 further explained to learners that our clock can be shown as a circle. When we cut it in half, we have a half (this assumes or gives learners the impression that all analogue clocks are circular in nature). When learners were still at crèche, they used to sing the song "re ba ba telelele." P1 stated that we wake up at 6; at 7 we take a bath and prepare to go to school, knowing that at 7h30 school starts. At 9h30 it is break. Asked what a half is, she demonstrated this on the clock by drawing a straight line through the circle. As the lesson progressed, P1 displayed various lines depicting half past. She asked learners questions and they raised hands to answer the questions, sometimes answering in unison.

The findings indicate that P1 uses the behaviourist approach to teaching, in which the teacher teaches and learners learn. Learners are taught as a whole class and opportunity is not created for small-group teaching. The teacher adhered to her professional identity and expert understanding of teaching.

A similar pattern was observed with P2 and P3. P2 started her lesson by asking learners to count forwards and backwards in 10s and in 5s. She then led the lesson by giving numbers representing a number using the Base 10 blocks. She put 2 blocks representing hundreds, 3 blocks representing 10s, and 4 blocks representing units. She asked the class to tell her what number she was representing, starting with the hundreds, continuing with the tens. Then P2 wrote the number as 200 + 30 + 4= 234. She then went further to draw non-proportional models to represent 400 + 10 + 3= 413. She continued by writing another example in which learners had to add 171 and 232 using the breaking-down method.





Figures 6.4 & 6.5: P2's Addition activities

P2 wrote further numbers to add, but using a different way of breaking down the numbers. Learners seemed to understand this method also, as they were able to answer correctly.

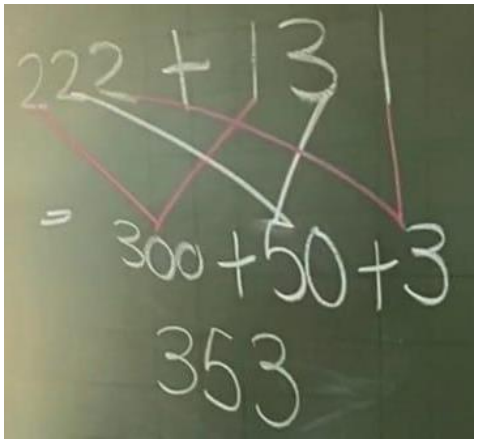


Figure 6.6: P2's Addition activity

During this lesson the teacher did all the talking and writing, then asked the learners questions, which they mostly answered in unison unless she called the name of the learner. What stood out in the lesson was that from start to finish, the lesson was solely taught in English, without code-switching, the school being an English-medium school. As with P1, P2 was in total control of the lesson, learners answering when asked questions.

P3 also introduced the lesson by asking learners to count orally as a whole class. She also asked the class to count the empty bottles (objects) on the table that she had placed in the front of the classroom. This means that the counting lesson covered the two topics of counting in numbers, operation and relationships. Subsequent to that, P3 asked learners by name to come to the front to select a number symbol and say what it was. She then told learners that on this day they were

going to learn to add. She started by using concrete objects, i.e., empty plastic bottles, cups, and bottle tops for the addition activity.

Figure 6.7: P3's counting and addition objects

In her lesson, as with P1, P3 also experienced the challenge of language when learners frequently used English to name the numbers, giving the total after addition.

A different pattern was the observed in P4's and P6's lessons. From the outset, P4 involved learners in the lesson. She used 100s base ten blocks for counting in 100s.

Figure 6.8: P4's counting activity before learners wrote number symbols

Learners could clearly see the blocks put at the front of the class. After orally counting the blocks in 100s, she called learners to come to the front, a boy and a girl alternately, to write a number symbol for each hundred representations in sequence.

Figure 6.9: P4's counting activity when learners filled in the number symbols

Learners were actively involved when completing this activity. Each learner was looking forward to being called to the front to write the next number symbol. The next step of the lesson was mental maths. In this activity, the teacher had prepared in advance a mental maths activity (addition and subtraction facts to 20 and from 20 onwards). P4 explained to learners that they were going to complete the activity and write answers.

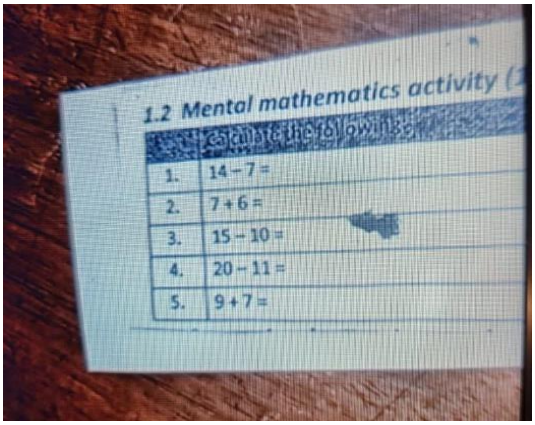


Figure 6.10: P4's mental maths activity

For this activity learners were also actively involved; the teacher was moving around to ensure that they were writing the activity. After this activity, the teacher taught the main concept of measurement, focusing on mass using informal measuring.

The teacher introduced the concepts of mass. She stood at the front and called a learner to come to the front. While at the front, P4 asked those seated to tell which one, between her and the learner, was heavier. The learners estimated that P4 was the heavier. P4 then called another learner to come and lift first the other learner and then the teacher to verify their estimation.

P4 continued by using an informal scale, explaining that they were going to compare the mass of classroom objects (box of crayons, cup, ruler, glue-stick, stamp and Sellotape) against Unifix blocks using that scale. The scale was made of two equal-sized buckets and a hanger.

Figure 6.11: P4's informal measuring scale

This activity was entirely practical and very engaging. P4 asked learners first to estimate and then to take the correct measurement. P4 demonstrated the first two, working with the learners, then asked learners to come to the front to do the measuring themselves.

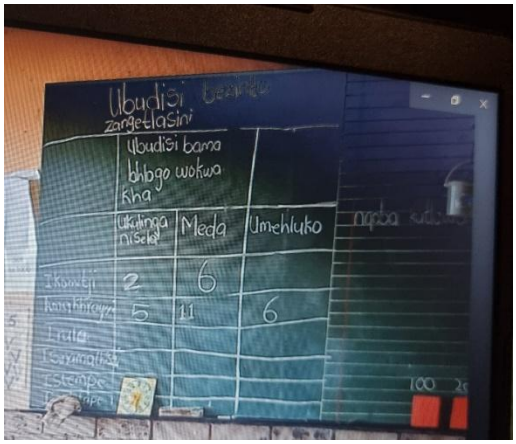


Figure 6.12 and 6.13: P4's measurement activity

In this lesson also, P4 was not only addressing measuring mass of objects. Incorporated was addition and subtraction, because after estimation, learners had to say how many more or how many less Unifix blocks there were than the actual mass measured. Unlike other teachers, P4 did not have a language problem as she and the learners engaged unfailingly and said number names and concepts in IsiNdebele.

The learner who estimated that a glue-stick is equal to 7 blocks estimated correctly. For this reason, the teacher commented that *"uyenze kuhle",* meaning *you have done well*, rewarding the learner with a sweet.

The teacher's understanding of estimation is that the answer is correct if the estimation was correct. This distorts the whole meaning of critical thinking. Estimation in itself does not mean that the answer must be correct, but that it should be close to correct and be based on learner's judgement. This was a failure of this lesson, as this gave the impression that those who did not give the exact mass were wrong, according to her. As the lesson progressed, this caused other learners to lose confidence in estimation; this was evident because the next learner who came to estimate next seemed lacking in confidence.

The lesson was consolidated by giving learners a worksheet on which they had to individually compare mass objects written on the sheet with the mass of Unifix blocks. The teacher asked

them to first estimate the number of blocks needed for the mass of each object, write it down, then do the actual measurement. This activity helped learners also to assess themselves.

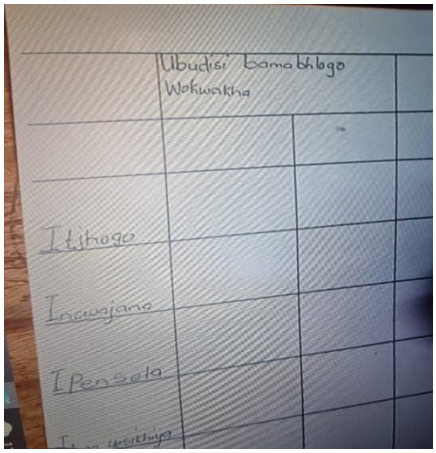


Figure 6.14: P4's learner worksheet

In this lesson, based on how the teacher presented the lesson, P4 played the role of a facilitator, representing her societal identity and common understanding. P4 ensured that all learners were engaged throughout the lesson. She promoted self and peer assessment and ensured that all learners, no matter their strengths, were accommodated. Again, in the lesson, the teacher combined the content-driven strength of CAPS and competence strength of the competence curriculum to deliver her lesson in a way that was educational and playful at the same time. Furthermore, in the lesson, a number of mathematical concepts were taught, although P4 did not do any planning for them; nevertheless, these fitted in well in the concept of the day. These concepts included addition and subtraction and listening to and speaking the languages.

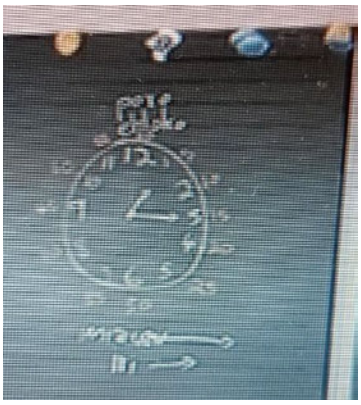
P6 started by greeting the learners, telling them in IsiNdebele that they were going to learn about time. The teacher asked a few learners to state the time they wake up. One said he wakes up *"ngo-five",* meaning at 5:00 a.m. P6 asked how many more wake at 5, those who wake at 6, and what time school started. When learners responded, they said the times in English. For example, when P6 asked what time the school started daily, they said "*ngo—eight".*

Asked how we read or see time, learners said "on the watch". P6 showed a circular analogue clock. He then asked learners to recite a time rhyme, *"Sifunda ngeskhathi".*

The teacher used the whole-class approach to teaching, time and again asking learners oral questions. During the lesson, learners were actively involved; however, P6 was dominating the

lesson. Learners were involved because the teacher gave them the opportunity to participate in the lesson.

Counting and mental maths were not planned for; however, learners counted the representation of minutes that P6 wrote on the clock face he had drawn on the chalkboard. Learners counted the minutes in 5s up to sixty to make up an hour. P6 then taught quarter hours and minutes, explained concepts, incorporating fractions by drawing a circle divided into equal parts. P6 then wrote numbers 3, 6, 9, 12, then the remaining numbers to finish the series 1 to 12. P6 also explained quarter past and quarter to, including the functions of short and long arms of the clock.



Figures 6.15 and 6.16: P6's clock representation

During the second part of the lesson P6 addressed the calendar. P6 explained that we also use another way of telling time. P6 took out a calendar and asked learners whether they knew the object. They replied that it was a calendar. P6 asked learners to say the months from January to December in IsiNdebele. P6 further asked learners what month of the year they were in and they responded *"Umgwengweni*" which is June.

P6 then explained that they were going to talk about June, giving each learner a June-only calendar. P6 spoke about the number of weeks, days, and holidays in June. P6 posed oral problems and gave answers, e.g., was there a holiday? When was it? What is the date today? How many days have passed between the holiday and today? Which day is the holiday ending?

P6 consolidated the lesson by calling 2 learners to the front. P6 told the learners to assume that they were his children. He then explained that one was born on the 20th of June and the other was born on the 25th of June 2022. Which one is older? Learner A or Learner B? How many days is

Learner A older than Learner B? Learners had to write their answers in the space provided on the calendar.

As with others, P1, P2, and P3, P6 also dominated his lesson, playing the role of a teacher, with learners listening and giving answers. There was not much practical engagement on the side of the learners, especially with the clock lesson. This may pose a problem when learners have to complete an activity in which they have to tell or represent time in different ways. Although P6 had to teach quarter hours and minutes, these concepts were not clearly articulated. On this one also, differentiating between the minutes and quarter hours may be a problem for learners going to the next grade.

The findings in this study are that all the participants understand their roles as transmitters of knowledge with qualifications and experience to teach in the foundation phase. Evidence from observation also supported their position, as it revealed that teachers, when they had to teach their Grade 3 classes, were all in control of their lessons. Only P4 attempted to play the role of a facilitator when giving learners the opportunity of coming forward and solving problems on their own. The findings are therefore not conclusive on whether these teachers can be classified as experts or as facilitators. Teachers do not meet all the criteria of being experts or facilitators as per the literature.

For example, Loughran (2011) argues that for teachers to be classified as experts, they should be aware of what they are doing and why they are doing it. These teachers should also acknowledge that teaching is an educative process. Teaching cannot simply be measured by a list of competencies; it should have expertise that is unique to them, especially in their subjects. Contrary to Loughran, Araffin *et al.* (2018) and Voskoglou (2019) identify expert teachers as teachers whose roles include their involvement in research, publication of articles and teaching materials, and professional development of other teachers. In the findings, only one participant understood one of his roles as that of a researcher. P6 indicated that, prior to studying to become a teacher, he had researched early childhood education. He had employed his personal capacity, using his personal identity and individual understanding. Nothing from this exercise was published, but it helped him in deciding to become a foundation phase teacher.

Expert teachers, according to Ornstein and Hunkins (2018), are influenced by behaviourism. These researchers maintain that behaviourists believe that curriculum is organised to enable learners to master the content that will be taught. Ornstein and Hunkins (2018) identified three behaviourist approach models to teaching and learning. The significance of stating objectives in

shaping teacher roles and teaching and learning activities was articulated. The first model is direct instruction: the Rosenshine model. The direct instruction model advocates for stating learning objectives in which teachers have to start the lesson with a short statement of objectives. In this study, none of the participants stated the objectives beforehand during the teaching. However, teachers were able to write in their reflections that their understanding of objectives is that learners have to master particular skills such as solving problems, working with numbers.

The second model is the mastery learning: the Block and Anderson model. The mastery learning model compels teachers to explain to learners what they are going to learn. This was evident in this study during observations when teachers started by telling learners that they were going to learn about a particular topic. For example, P1 and P5 told learners that they were going to learn about time in hours, half hours, quarter hours, and minutes, respectively. Such statements set learners up for what they will have to have mastered at the end of the lesson. This will subsequently lead to how they will be assessed.

Last is the guided instruction: the Hunter model. For this model, the teacher has to state explicitly what will be learned. The teacher has to state the rationale behind learning the particular content and how will it be useful to the learners. Similarly, with the direct instruction model, during the lesson, participants did not explain to learners why they were teaching a particular concept and how it would benefit the learners. However, in the reflective activities, teachers indicated that learners' ability to work with numbers leads to their correct use of mathematical language, ability to make calculations and reason logically, as stated in the mathematics CAPS (DBE, 2011a). Through observations, except for P4, who attempted to adopt the constructivist approach to teaching, the rest of the teachers reflected the behaviourist approach. These teachers taught, made learners repeat after them (teachers) in unison, and do what the teacher said they should do.

Graven and Westaway (2019) identified an expert teacher as a teacher whose teaching task in their subject is a priority and prescribed by the Ministry of Education. Teachers in this study, individually, meet some of the criteria identified by researchers. All teachers meet Graven and Westaway's (2019) criteria. Furthermore, Voskoglou (2019) raised as a concern that foundation phase teachers are not specialists in the subjects they are teaching: nonetheless they teach mathematics and many other subjects prescribed in the curriculum. This was contradicted by Idah's (2017) opinion that, knowing the subject, level of qualifications, intelligence, competency, and experience does not make a teacher an expert. There are many teachers who have all these qualities, nevertheless, their learners are underperforming. This is evident in the

findings: teachers made it clear that they are teaching mathematics because it is a compulsory subject, and not because they know the subject well or have a specialisation in mathematics from a HEI. Based also on the findings, these teachers are not facilitators of learning.

An expectation that teachers are to be facilitators is the strength of competence curriculum. Teachers aligned with this have a common understanding of curriculum, and are informed by their societal identities of teaching and the constructivist approach to teaching. Constructivist teachers have the responsibility to embrace and understand the learners' prior knowledge, which is predominantly informal. This guides the activity to address them and then build on them (Shah, 2019). The findings in this study revealed that some teachers understood their roles as mediators between the department and parents as they are the ones who have access to both. Again, these teachers also esteemed collaboration, which is also aligned with common understanding. This understanding promotes constructivism. The practice promotes social structures and activities in which the communities and environments are concerned. Khoza (2021b) maintains that constructivism is about everyday knowledge used by teachers when they push for achievement of outcomes. Collaboration may also include joint planning with other teachers teaching the same subject in the school, cluster, or circuit, as Mabuza (2018) pointed out. Additionally, teachers are encouraged to support learning and to prepare learners rather than instructing them on what to do and how to do the activities (Hanewickz, Platt and Arendt, 2017).

The reason that they are not instructors does not reduce their power. The teacher is still in control, being responsible for planning and designing the learning activities and giving these to learners to complete. As facilitators, teachers have to allow learners to use their own problem-solving skills, lessons learnt from their immediate environment about a particular content, answering using knowledge from society (Khoza, 2021b).

Direct teaching in the foundation phase, even in the mathematics CAPS is discouraged at all costs; however, findings are that teachers, in practice, were directly teaching. Their teaching and learning activities were prepared that way. To some extent teachers did not have a choice, but had to resort to whole-class teaching due to overcrowding. In more than two instances, participants raised concerns of overcrowding as a factor that impacts how they teach. Overcrowding prevents teachers from teaching smaller groups and being able to identify learners who may be experiencing barriers to learning. Some participants even wished for the COVID-19 era again, as they were teaching very small groups of learners due to the rotational model that their schools had adopted then. Literature found that overcrowding is a deterrent factor for

teacher and learner motivation, productivity, quality of teaching, and learning activities, learner performance, and classroom management (Durmuş, 2016; Ibem *et al.*, 2017; Sithole, 2017; Mabuza, 2018; Ndethiu *et al.*, 2020).

Based on the findings and requirements of the mathematics curriculum, participants were neither experts nor facilitators, and their activities were teacher- and content-centred. In principle, during reflections, teachers portrayed an understanding that they are national assets who strive to be considerate, putting learner needs to the fore, promoting inclusion through support, and at the same time being loyal to the prescripts of curriculum. In practice, teachers were in control, teaching what they had prepared without deviation, leaving out some of the areas of focus such as counting and mental mathematics. Teachers used their individual understanding and aligned themselves with their personal identities.

The implications of the findings are that innovations on the curriculum may often seem to be unsuccessful: teachers in the system have limited understanding of what concerns their profession. This implies that teachers understand something of performance curriculum principles, something of competence curriculum principles, but have limited support to reconcile the two. Support in this context is the Department of Education's support for teachers in terms of their development in practice and in infrastructure provisioning. The situation was aggravated by the COVID-19 pandemic. We witnessed the principles of the current curriculum being flipped to accommodate the impact of the pandemic in the schooling systems. Content was altered, assessments were adapted, and in the foundation phase formal tasks were no longer considered for promotion purposes. Promotion requirements were relaxed in other phases. The learning environment and resources were also re-engineered, where utilisation of online learning environment and digital resources were strengthened.

6.3.3. The learning environment and resources

There is consensus in literature that a learning environment is one in which teachers, learners, resources, and facilities effectively interact: one cannot function without the other (Adnan *et al.*, 2014 & Mabuza, 2018). A learning environment can either be real-life, online, or blended, as discussed in the literature.

In this study, all participants taught their lessons in a classroom at a school, which is a real-time learning environment. Firstly, teachers could not have done this any other way due to lack of digital resources. Secondly, the nature of the CAPS curriculum, especially in mathematics, is

designed in such a way that the teaching is confined to the classroom. Even most of the practical activities, such as measuring length, are performed in the classroom. Learners measure classroom objects both informally and formally. It is in the content area of data handling that teachers may go outside or ask learners to collect items, even when they are at home, so that they are able to analyse and represent data about the collected items. For this reason, all participants, in respect of the learning environment, used their professional identities with expert understanding to align with the performance curriculum. None of the teachers explored the online learning platforms, all learners being at school.

Regarding resources, all participants used the concrete resources in their lessons. Only P1 did not have any other resource barring the chalkboard as a primary resource. On the one hand, P2, P3, and P6 used minimal resources. However, they managed to ensure that those resources were effectively utilised to teach the concepts. On the other hand, P4, to teach the concept of mass, used a number of classroom objects that assisted her learners to grasp what was taught. With the teachers' understanding of resources, it is also evident that teachers maintained their professional identity; they did not explore other resources that could be used to teach mathematics, especially those online. This is consistent with their reflections in Phase 1 and Phase 2. It seems that even had they wanted to, their classrooms are not equipped with devices that support access to those online resources. These include SMARTBoards, laptops, and projectors that enable access to activities on YouTube or mathematics blogs, even electronic worksheets.

Findings from both observations and the two phases of reflective activities show that, even during COVID-19 lockdown, for these teachers, teaching and learning did not take place; they did not have relevant resources for online teaching. Not only did they have no resources, but they also had no skills in using the online learning environment. This challenge is consistent with the findings in other studies regarding availability, accessibility, and utilisation of online learning environments and resources, which Khoza & Mpungose (2020) refer to as LMSs. According to literature findings, the identified gaps are not limited to, but include lack of training for teachers, lack of resources, poor attitude towards the LMSs, time constraints, increased workload, and lack of support (Son & Hu, 2014; Mukute *et al.*, 2020; Khoza & Mpungose, 2020; van der Spoel *et al.*, 2014; Alexander, 2022). Firstly, one of the most challenging aspects of implementing online teaching and utilising resources maximally was that teachers were not trained.

The basic education sector, in the province's circuit where this study was conducted, did not provide schools and teachers with resources such as laptops and data bundles to access the online

teaching and learning environments such as MS Teams, Zoom, and D6. Hence Khoza and Mpungose's (2020) and Mukute *et al.*'s (2020) argument that this causes what is known as the digital divide: continuity favours the digitally literate with physical and financial access to online learning. For this reason, teachers in this study experienced similar challenges, their schools being in a semi-rural context, with learners attending no-fee paying schools, and coming from impoverished family backgrounds. It is undeniable that, without learners, there will be no need for having a school curriculum. The curriculum is developed with learners in mind; hence we see that even the aims of the curriculum are directly related to the type of learners envisaged to be produced by the national curriculum. Therefore, teachers, irrespective of whether they understand or implement the curriculum for the expert, common, or individual understanding must have an understanding of the learners they teach. This understanding helps teachers to embrace their identities.

6.3.4. Assessment

Each of the participants consolidated the lesson with an activity that assessed their understanding of the concept taught. P1, P2, P4, and P6 used worksheets that they had designed; and P3 used a DBE workbook activity. All these activities were informal assessments, assessing whether learning had taken place. They were formative in nature as learners will not be graded with these activities at the end of the term. The outcomes of the activities may have helped the teachers to assess whether their lessons met their set objectives.

Based on the reflective activities and observations, the first research question, 'What are the teachers' understandings of the implemented mathematics curriculum?' was answered. The findings are that in both reflective activities, participants have not always been consistent with the operational 'how?' The operational 'what?' was when teachers were observed in practice, teaching. This inconsistency therefore puts teachers in a position where they are neither aligned with expert understanding nor common understanding, which leaves them more aligned with the individual understanding, being aligned with both professional and societal identities. For example, on content, all teachers adhered to the CAPS curriculum content without deviation.

The slight deviations were seen in P2 and P3 who did not teach mental maths; and P6 who did not teach both counting and mental maths. Teaching and learning activities for all participants were direct teaching and learning, except for P4 who had from the beginning involved all learners. In the reflective activities, participants also mentioned issues around inclusion and on accommodating learners with barriers. This was observed in instances where a learner did not

give the correct answer. The teacher would ask other learners to assist. However, learners were not made to understand why their answer was not correct and why the other answer was correct. Even the written activities were not inclusive, as all learners wrote same activities. Activities were not adapted to accommodate struggling learners. What also came out of the analysis, although not a topic under research is the issue of the LoLT.

In all lessons, except in P4's lesson, the English language dominated the way in which learners answered questions, especially how they say the number names and tell the time. Teachers' tongues also slipped; they uttered some English words during the lessons. Even when teachers indicated that these learners are from impoverished backgrounds where parents have little or no access to resources at home, learners are still nurtured in communities where they can access the basic English language to navigate through their daily lives. What the participants reflected was an understanding of the learners they teach. This was except for P2, who missed the point of other languages that their learners are exposed to in and outside the school environment. In 4 of the 5 schools in which the participants of this study teach, English is taught as first additional language, which may also be contributing to knowledge of some mathematics concepts in English. Another factor that emerged is that at P2's school, the LoLT is English. However, not even once did the teacher utter a word in an African Language during teaching and learning. This is despite both the teacher and learners being Black South Africans, speaking predominantly IsiNdebele and Sepedi as their mother tongue. Throughout the lesson they maintained conversation in their LoLT, not code-switching. It is against this background that a study on which language is best suited to the teaching of mathematics, especially in Grade 3, as an exit Foundation Phase Grade, should be conducted.

The language of learning and teaching mathematics in the foundation phase has over the years been a thorny issue, and has been intensely debated across the globe. Some researchers argue that learners learn mathematics best in their mother tongue, as this has determined early learning success and improved learner performance (Sua & Santhiram, 2014); Mackenzie & Walker 2013; Lindholm-Leary and Rodríguez, 2015). Shuukwanyama *et al.* (2022) agree that when learners are taught in their home language, it becomes easier for them to understand the how concepts and be able to express themselves fluently, which transform them to be critical and innovative thinkers.

By contrast, Essien (2018); Botes and Mji (2010) argue that mathematics as a subject has its own specialised language learned through language. During the process of learning, there is reading,

writing, listening, and discussion involved, all of which are heavily language-based activities. This requires that learners who are not first-language speakers of the language of teaching and learning be proficient in both their mother tongue and the LoLT. Therefore, there are no conclusive reasons as to which language is best for teaching mathematics.

6.4. Conclusion

This chapter presented the discussion of findings on data generated from reflective activities, observations and interviews. The intention of these discussions was to determine teachers' understanding of the implemented mathematics curriculum using themes aligned with the NIF. The use of the themes assisted in answering the first research question. Findings revealed that Grade 3 teachers have differing levels of understanding of the mathematics curriculum. For example, regarding the understanding of aims, objective and outcomes teachers did not say outright whether these were curriculum aims or personal objectives. The question of whether their goal for teaching was aligned with aims, objectives, or outcomes was determined by the researcher during analysis. With content also, teachers all understand that when teaching, what we teach is from the mathematics CAPS document and must be adhered to.

However, in the reflections, what also emerged is that participants seemed to have a challenge regarding what to classify as content. The prescribed mathematics content is broad. It needs teachers who have strong content knowledge and understanding to be able to differentiate between content areas, topics for each content area, and concepts and skills in each topic. Unclear identification may compromise the quality of teaching and content coverage.

As this study was a pragmatic action research, the analysis also sought to determine whether to some extent teachers' understandings have been altered in any way. The findings are that, ultimately, teachers found it difficult to follow the prescripts of the mathematics curriculum, especially in practice, even though they know that there is a standard procedure to follow. Although language was not part of curriculum understanding, it emerged as a challenge for Participants 1, 3, 5 and 6; Participants 2 and 4 used English and IsiNdebele, respectively. It was difficult for the participants to maintain teaching using mother tongue as prescribed by policy. Therefore, during the two phases of data generation, some participants reached the stage where they prioritised their individual understanding more; they decided to incorporate the expert and common understanding to navigate the mathematics curriculum. The next chapter therefore

discusses the philosophical ‘why’ question, thus establishing why teachers have a particular understanding of the implemented mathematics curriculum.

CHAPTER 7
ADDRESSING TEACHERS' UNDERSTANDING TO ANSWER THE PHILOSOPHICAL 'WHY' QUESTION OF THE STUDY

7.1. Introduction

The foregoing chapter presented findings from reflective activities and observations to answer the 'what' question regarding what Grade 3 teachers understand to be the implemented mathematics curriculum. The question was complemented by 'how' they teach and this was explored through video observations of when they each teach a mathematics lesson. This chapter serves the purpose of analysing data from one-on-one interviews and focus-group discussion to answer the second research question: 'Why do Grade 3 teachers have a particular understanding of the implemented mathematics CAPS?' This question is regarded as a philosophical question because it portrays teachers' understanding beyond their expert, common, and individual understanding identities as a more critical and reflective understanding identity which is innate to each teacher. Because this study is a pragmatic action research, the interviews form the final phase of this study. The participants are reflecting, assessing, and critiquing their actions. I, as a researcher, present the contribution this study makes in improving teachers' practice.

The chapter, therefore, seeks to address the alleged tension and its outcome by presenting new knowledge which embraces the diverse understanding identities of teachers as they develop. This will allow for the type of teachers' understanding that addresses and embraces issues that will encourage the mathematics curriculum to flourish, without collapsing the boundaries between them. The themes from the previous chapter, which are goals, content, teacher roles, and teaching and learning activities, assessment, the learners they teach, and the learning environment and resources are maintained. Additionally, a new theme, which is the rationale, is added in support of teachers' answering why they have particular understanding of the implemented mathematics curriculum.

7.2. Exploring teachers' rationale for why they understand the implemented Grade 3 mathematics in a particular way

Pertinent to curriculum implementation for teachers as frontline implementers, is to understand the rationale, which is divided into three main categories − the professional, the societal, and the personal (Berkvens *et al.,* 2014; Khoza, 2016; and this study categorises rationale as either expert, common or individual. Tyler (2013); Berkvens, *et al.,* 2014; Khoza (2015a) and Khoza (2018) posit that to frame all curriculum activities, successful teachers start by identifying and understanding their rationale for teaching. This understanding helps the teachers to reflect on

their teaching in order to improve their teaching practice; this understanding is also important to ensure successful education reform.

After all that the participants have said and done and all the discussions subsequent to the reflections and observations, interviews and focus-group discussions were conducted with the aim of giving participants an opportunity to re-reflect. These two data-generating methods were found to be more suitable − participants were given the opportunity of deliberating freely and openly what they had already said in the reflective activities and done when they were being observed while teaching. A focus also has the potential of generating rich in-depth data if it is well planned (Dlamini, 2022). In both interviews and focus group, the researcher has the opportunity of asking probing and follow-up questions to obtain rich insights into participants' thinking.

The interview session and focus group were found suitable because questions were open- ended; participants had the opportunity to expand on what they personally understood to be the implemented mathematics curriculum. Furthermore, the findings revealed that these interviews and the focus group were necessary: through probing and engagements participants were able to realise that a teacher can have more than one rationale when teaching a subject. The participants had the opportunity to reflect and to move from embracing their rigid understanding to becoming flexible and more reflective.

The main question of the two sessions was the rationale − the whole curriculum revolves around the rationale. The following section provides a detailed account of why teachers' understand the implemented mathematics curriculum the way they do. The previous chapters acknowledge that teachers are at different levels of understanding, informed by their diverse identities in curriculum. This, therefore, causes tension and sometimes contradictions as to which understanding and identity has more power, or is more suitable or correct than the other to support the implemented mathematics curriculum.

During interviews teachers were open and the responses were longer than during reflections. Quoted texts show that participants were referenced verbatim. Similarly, with the focus group, participants were further able to filter their responses based on what others had already said Reasons provided by the participants were informed by them. It was anticipated that the participants would answer aligning with what they what deem their understanding of the implemented curriculum. It emerges that most of the participants' rationale for why they teach mathematics is that it is a compulsory subject and they have therefore to teach it. Firstly, this

suggests that it is a prescript in that, during their deliberations they mentioned that in the foundation phase, mathematics is a compulsory subject; it is a requirement that learners pass the subject so as to be promoted to the next grade. This suggests that, according to the teachers, mathematics is somewhat imposed on them.

7.2.1. Teachers' justification for their understanding (rationale)

During interviews and discussions, teachers were open; and the responses were longer than during reflections. Quoted texts show that participants were referenced verbatim. Reasons provided by the participants were informed by them. It was anticipated that the participants would answer aligning with what they deem their understanding of the implemented curriculum.

Findings revealed that teachers have various levels of understanding of their rationale for teaching mathematics. Highlighted is that these teachers' rationale was subconsciously revealed by them through their responses. The teachers' subconscious and conscious minds function through experienced social, and/or professional actions, whereby teachers are subconsciously influenced by their environment (Khoza & Makumane, 2020, Khoza & Mpungose, 2020; Khoza, 2021b). The teachers' environment includes the learners they teach, content knowledge, pedagogic knowledge, and their identities, among other things.

P1: *"I am teaching mathematics because maths is key subject that promote our leaners. I teach to produce learners who are confident in solving real life problems. …to develop knowledge in these learners. I want to change their lives so they don't forget me. I was not good in Maths at school and didn't like it, but Foundation Phase maths is easy mam and is very easy for my learners to pass."*

P2: *"…everything revolves around numbers. Our lives have numbers around them. Shops, hospitals, roads etc. as a teacher it is my duty to help learners' lives become easy now and in the future."*

For P3: *"To develop the creative thinking of the learners. To give them support… knowledge about mathematic. Mathematics is compulsory. it is important to teach it because it provides learners with vital life skills and one of them, for me is to be able to solve problems and also to enhance the e power of reasoning"*

P4's understanding is more personal as she mentions that *"I teach because, mmmhh, mina (I) mam, I am a good teacher and a hard worker. My experience, I … I can say helps me. The other thing is that in Foundation Phase, maths is compulsory. Mathematics is involved in their real*

life situations. When learners go outside their classrooms, they do encounter mathematics. …Mathematics goes hand in hand with other subjects. If it was not, mam bengizofundiza (I was going to teach) IsiNdebele because abentwana (learners) are struggling in their language."

P5 was not hesitant to say: *"Eeeh, mam, I learnt to love my job as a teacher, but it is not what I wanted to be. Hehehe! You know we all want to be doctors when we grow up, hahaha, but it ends there, as a dream. Now I am teaching to develop critical thinking and to enable the learners to make fair judgements in their daily lives. For example, if a learner wants to be an architect, having a good mathematical background can help to be successful in their career choice. Learners should be confident and not be afraid of Maths. "*

For P6: "… *I did research before I went to varsity. My research showed that Foundation Phase is problematic in Mathematics because learners do not get foundation form creche… The children are not well trained in mathematics. I went to pre- primary school and did research of what is the problem and found that the problem is the curriculum. Then I decided to go to university of Fort Hare to study foundation phase so that I can teach mathematics for learners to get knowledge and skills as without mathematics these learners cannot do anything. Maths is everything…we cannot live without maths. Yoh (sighs), if these children are not well taught sisenkingeni (we are in trouble) mam because the whole nation is doomed."*

Similar sentiments were shared by participants during focus-group discussion. P1 built on what she said during interviews, adding that *"I as a child was always with a teacher who could not teach maths… they are teachers that have theory, but unfortunately they cannot bring it across to the child. Then children don't choose mathematics because there is no understanding."*

Based on all participants' responses, none was driven by one rationale, but by a combination of rationales, i.e., expert, common, individual, or a combination of two or three of these rationales. In providing reasons driven by the expert rationale, for example, P1, P3, and P6 stated that they teach mathematics because it is a compulsory subject in Grade 3. It was even mentioned by P1 that it is a requirement that learners must pass mathematics to be promoted to the next grade. P1, P2 and P6 further understood their reasons for teaching mathematics as a responsibility of developing the learners' knowledge of mathematics by making them understand mathematical concepts and developing their critical thinking skills.

After probing, except for P5, the accounts of all teachers' rationale for teaching mathematics are not directly or in any way related to their qualifications, what they learnt at school and institutions of higher learning or their own love for mathematics. Their rationale for teaching mathematics

is founded on the prescripts of the mathematics curriculum. This means that it is a policy prescript, an obligation; and they do not have any other option but to teach it.

Unlike in the other phases of schooling such as intermediate, senior and further education and training phases, foundation phase teachers teach all the four subjects in their grade during class teaching, not subject teaching. It is in only in rare cases that a teacher in the foundation phase teaches one or two subjects across the phase. This happens in instances where the departmental head or deputy principal for foundation phase are overloaded, and they are allocated that one subject to teach instead of the whole class. This subject is not mathematics in most cases because mathematics is highly ranked; passing it is a mandatory promotion requirement and it must be taught for 7 hours every week. Hence, it is not allocated to members of the school management team (SMT), to avoid gaps in content delivery.

In instances in which the participants were driven by the common rationale, they put society and societal needs to the fore. All participants maintain that mathematics is everywhere and it is life; because we need it to navigate our daily activities. P3 added that mathematics provides learners with vital life skills. For normal daily routines there is a time for waking up; work starts and ends at particular times of the day. One has to remember one's date of birth and what day it is. We need to know how much we spend on our groceries, petrol, and other essentials. All these, and many more things in our lives depend on people's basic understanding of mathematics for them to be able to navigate their daily lives. Hence P1 and P5 even maintain that their rationale is to develop confidence in mathematics and critical thinking to enable the learners to make fair judgements in their daily lives. Mathematics is, therefore, viewed as an empowerment tool and a social phenomenon that socialises people through their daily activities.

Teachers who were driven by individual rationale were open in their responses, justifying their reasons. Their rationale for teaching according to P4, P5 and P6, included experience as a teacher, being a good teacher, a hard worker, the love of the job, and research conducted before studying further. However, being a good teacher may cover a wide range of activities, including knowing and understanding content, teaching the content well and having a good relationship with learners or other stakeholders in education. Furthermore, although P4 regards herself as having experience in teaching, her priority is to teach and develop learners' mother-tongue, which is IsiNdebele, more that she would teach mathematics. The reason for teaching mathematics is because it is compulsory to teach it.

P1's understanding is that mathematics is an easy subject to teach in the foundation phase and everyone needs mathematics to navigate everyday life. Past failures and incompetence, according to her, do not prevent anyone from teaching a subject at a later stage. P1, 3, 5, and 6 portrayed an understanding that teaching mathematics is key to developing learners mathematical knowledge, creative and critical thinking. Based on the findings, all teachers understanding of their rationale for teaching mathematics were informed by their expert, common and individual understanding identities and this suggests that they are ready to explore their natural understanding identities to locate their innate rationale by engaging in a reflective practice.

7.2.2. Goals

In the foregoing chapters, researchers are in agreement that goals in education are what make curriculum what it is and help to provide direction of focus on what needs to be achieved. Understanding goals is important for teaching quality, goals being connected to content and learning activities (Tyler; 1949; Galane, 2016; Khoza, 2015; Mabuza, 2018; Ornstein & Hunkins, 2018; Betti, 2021; Stockinger *et al.,* 2021). Khoza (2016) and Dlamini (2022) argue it is key for teachers to have the ability to identify and understand the mathematics curriculum vision as this informs the teaching and learning process. Researchers argue that goals are not tailor-made for each teacher to achieve, but they are aims that teacher have for themselves in relation to their practice; and are achieved through a teaching and learning process that teachers embark on (Khoza & Biyela, 2020; Anderson, 2020).

In this study, goals are divided into three categories, namely, objectives, outcomes, and aims. The findings indicated that in mathematics, teachers were not able to contrast the objectives, outcomes and aims. They contextualised the terms and personalised them to answer according to their own understanding. As a researcher, I had to interpret their terms and place them into categories.

When asked why they understand the goals of mathematics the way they do, most of the participants indicated that this is because, when teaching mathematics, it is expected that by the end of the year the learners should be mastering the mathematics content for their grade. For example, they have to count and compute up to 1000, understanding the mathematical language and concepts for the grade. Reasons for participants understanding goals as they do revealed that they either deliberated more on objectives or aims or both, but less was said about outcomes.

P4 said that *"when I started teaching, we used to have a syllabus and we were also given outcomes. It was literally because the outcomes for maths for the year were outlined and teachers had the freedom of how they were going to teach it and when they were gonna teach it. Unlike now, everything is prescribed, especially how to teach and pacing of content."* When other participants heard P4's reasons, they started agreeing with her, as most of them taught started teaching during the apartheid era. They moved from expert understanding aligned with objectives, to common understanding that outcomes determine what learners should be able to do at the end of the year.

When hearing what P5 had to say, the participants found themselves conflicted in their understanding. P5 said *that "mam, objectives are nearly the same because we are guided by the CAPS and they also lead us to achieving the outcomes. I find this to be unfair because our contexts are different but yet the outcomes that they expect have to be the same. The level, the playgrounds on which we are playing is not the same."*

The challenge with classification of goals into various categories overlaps into the daily planning of lessons in which teachers are unable to specify such in their lessons. However, when preparing lessons, when teaching, and when trying to justify what they understand to be their goals of teaching, it is then that one is able to understand whether they are talking about objectives, outcomes or aims. The findings of this study are consistent with literature that educators at all levels are not able to differentiate or identify and categorise the curriculum goals. This study therefore proposes that teachers should be allowed to use natural understanding as to what they need to achieve as other understanding, even if hidden, is already covered in the curriculum. Teachers would be able to reflect after teaching a particular lesson/topic/skill to see what they have achieved. Therefore, to address this confusion, the study's NUIF is found to be suitable such that teachers were given an opportunity to practically plan and prepare lessons showing the objectives and outcomes of the lesson. Teachers started by first reflecting on what they used prior to the study, critiquing it and designing a plan that was meaningful to them, at the same time covering core mathematics concepts. This exercise also helped teachers in selecting suitable content to teach.

7.2.3. Content

Content is knowledge selected into the curriculum and what learners are to be taught. This entails subject matter knowledge, skills, dispositions, understanding, and values (Berkvens *et al.,* 2014;

Woods & Hedges, 2016; Deng, 2021). Content is an essential resource; and to teach is to commit, consciously or unconsciously; that one is promoting knowledge that is vital for social reproduction and innovation, human development, and the flourishing of learners (Deng, 2018). Furthermore, when one engages in a discussion about classroom teaching, central to that discussion is content (Deng (2021). In countries where content is prescribed, such as in South Africa, curriculum developers decide on what should be taught and presented, prompting teachers to become experts in their subject fields (Hoadley & Jansen, 2018; Mabuza, 2018). Therefore, teachers have to be curriculum makers who must grapple with the intellectual and moral questions of content to be taught, why it should be taught, and how it should be taught within a particular classroom context (Deng, 2018). It should also be noted that prescribed content is one of the pillars of the performance curriculum.

All participants in this study, during two cycles of reflective activities, mentioned that they are teaching content from the mathematics CAPS, going to the extent of mentioning the content areas of mathematics that they are to teach. It was also evident during observations that teachers are sticking to content from the CAPS. There was an attempt by some participants to integrate the concepts with mathematics; and some taught solely one topic, without integration; still, it was the prescribed content. During interviews teachers deliberated that they have to teach content as it is, because it is prescribed and in the mathematics curriculum document. There is heavy reliance on prescribed content; and deviation is minimal because teachers fear being charged with non-compliance by curriculum officials. However, when interrogated further, some participants, in a reflective mode, indicated that the same prescribed content is too much to teach and too difficult for learners to grasp. This becomes an overload for them as teachers, who ultimately teach what they deem important to teach.

According to P2 what she understands to be the reason for teaching is that "*... when teaching I have to follow policy, but at times, eish…mmmmmh…. our learners struggle. The information in the CAPS is too much for Foundation Phase learners. Maths policy is the biggest of all the CAPS documents and I don't understand why. The thing is I have been teaching for long, and I know what to teach and what is important. The new things in the CAPS are mental maths and counting. They waste time to be honest."*

P3 said: *"Yoooh (sighs), it's too much. I have to teach my class also; not only maths mam, all the four subjects. To survive, I look for only important topics, the Covid topics. I know they are*

important because department when it was bad, they gave us only those topics to teach. It is easier this way and learners do well."

Despite content being adjusted and reduced to close the curriculum losses incurred during COVID-19, these teachers still maintained and upheld their expert understanding. When other teachers praised the adjusted mathematics content, P6 contrarily was complaining that *"... not working for me lot of things have been cut off, which compromises the quality of what we were supposed to teach. Therefore, children don't know anything, so when they go to Grade 4 they will not be knowing anything."* In this account P6 is between expert and common understanding identities as he is concerned about the quality and quantity of content to be taught to learners, at the same time concerned about his learners' transition to Grade 4 with many mathematics concepts not learnt.

P5, when asked about content, indicated that "*Mathematics is divided into 5 contents and this what we have to teach. The problem is that the mathematics CAPS for Grade 3 is such an elaborative curriculum"* His argument, when probed, was that there is too much content; and this is not working for teachers or learners. As teachers they are just ticking boxes for compliance with curriculum coverage because officials come to visit schools, checking this. Content that they are teaching is most of the time irrelevant: *"If I look at the Grade 3 curriculum and I look at what we're teaching, breaking down method of addition to the children. In what real life do they use breaking down method? They don't. I'm telling you straight, I teach them vertical addition and subtraction because in real life up to today I use it, and it works. I teach them multiplication the old fashioned way because they remember it and I'm not afraid to say that to anybody because it pays dividends in the end."* His main argument is that the curriculum is too packed because it is full of irrelevant content that learners that will not benefit learners in the future.

Other participants agreed with him and they started reflecting that they were schooled during the apartheid era and acknowledge that many things were wrong then, but the curriculum was streamlined. They can still remember what they were taught then. P4 said, *"My learners now, if I go to class on Monday and ask them what we did on Friday, none of them will remember, I have to start all over again."*

This was a swift move from relying on their expert understanding identity to their individual understanding identity as they elaborated such. Teachers teach mathematics in the foundation phase because it is also a compulsory subject, not because they love the subject or are specialists.

P4 also lamented that if it was possible, she would only be teaching IsiNdebele as she knows that learners are struggling in Home Language. "*The other thing is that in Foundation Phase, maths is compulsory. If it was not, mam bengizofundiza (I was going to teach) IsiNdebele because abentwana (learners) are struggling in their language."* This suggests that, for P4, mathematics is not her favourite subject; she is simply complying.

Noticeably, none of the participants related their understanding of foundation phase mathematics content to what was taught to them at school or at institution of higher learning, be it at university or college; because mathematics is not a requirement for admission to a foundation phase programme. Teachers have, therefore, not specialised in mathematics when studying. This is consistent with literature findings about foundation phase teachers that most of them are teaching the subject but are not qualified to teach it. Adler *et al*., 2005; Pourmara *et al.*, 2015 confirm that teachers of mathematics in primary schools are not qualified or have no training as mathematics teachers therefore find it difficult to teach mathematics as a subject.

Teachers moved from the comfort of appeasing their expert understanding identity to interrogate their individual understanding identity for them to easily navigate the overloaded content they are supposed to teach. They argue that COVID-19 taught them that there are important concepts and skills that are deemed core and necessary to teach in mathematics. These form the basis of fundamental mathematics knowledge that learners need to know before moving from one grade to the other.

During the focus group, the participants brought forth another dimension of why they understand the mathematics content the way they do. They maintained their arguments still, regarding the state of curriculum. They admitted that the mathematics CAPS was somewhat similar to the Apartheid regime curriculum. However, according to them, the mathematics CAPS content has its own challenges which they believe make it difficult to implement.

P3 *"The content is fine, we need those content areas, but is too much. Our curriculum is too prescriptive and we also struggle to do curriculum coverage. This stresses us because it affects how we plan and if you did not cover all the content for the term you are in trouble with the CIs"*

P4 *"The problem came with the ATPs because they are too prescriptive. It has five concepts in a week. The teacher is confused and so are the children. For me, is to have the old scheme of work and maybe not have this curriculum coverage and officials stop moving around looking for it. Why do we need to have this extra admin?"*

Other participants agreed with P3 and P4 and added that outcomes should be clearly stated and teachers allowed to be autonomous and given the freedom to teach concepts the best way they can. Teachers' opinion is that this will assist in enabling learners to master these concepts. The participants further added that the tight monitoring by subject advisors is overwhelming. There was an obligation towards curriculum coverage without support being provided. The time for extra administration should be redirected for remediation and corrections.

At school level, curriculum managers expect teachers to carry out lesson planning in a manner that does tamper negatively with the intended curriculum, therefore, teachers must set realistic and achievable standards (Bartell, 1989). However, the overloaded curriculum, lack of materials and resources and low student motivation pose challenge in meeting these expectations (Dasas, 2021).

When teachers reach this state of understanding, this becomes their natural identity; they free themselves from the expectations of the experts and society and follow what works for them. To some extent these teachers use their individual understanding identity as they adhere to their common expertise and individual experiences in teaching based on what they have been taught as students of mathematics in the past. The NUIF advocates for the merging of the three understanding identities to allow for teachers to adapt and teach content that they best see fit to teach and understand. This is because DBE has declared that there are learning gaps that have been identified; and that these gaps have developed long before COVID-19. For this reason, teachers have to deliver strategies to fill these gaps, over time. No prescription of time has been provided; therefore, teachers have to seize the opportunity and utilise the available time profitably. The teachers are able to work with what works for them; and if, over time, this becomes redundant, they will reflect and re-adapt; this is in line with the pragmatic action research.

7.2.4. Teacher roles and teaching and learning activities

According to Deng (2018), teaching is a process of passing on a body of disciplinary knowledge that students cannot acquire at home. Teachers have the responsibility to impart content or knowledge that is deemed powerful for learners at different ages; and to take learners beyond what they already know. Therefore, it is imperative that teachers have an understanding and capacity to interpret the national curriculum, utilise this understanding to identify knowledge in light of the central purpose of schooling – the 'why' of teaching – with a view to creating educational encounters in the classroom through addressing the 'how' of teaching (means and

methods). Participants do understand that as teachers they have a role to play in the teaching of mathematics in Grade 3, i.e., to teach and expose learners to activities that promote the learning of mathematics content, concepts and skills. It has been argued in the forgoing chapters that teachers assume roles as experts, facilitators, or as researchers.

Teachers who have expert understanding of their roles emphasised that their main role is to teach learners. They do not believe in learners initiating their own learning. According to researchers (Aydin *et al.*, 2010; Loughran, 2011; Westaway *et.al.,* 2019) these teachers' expertise is shaped mainly by their experiences. They regard their roles as those of transmitters of knowledge and those learners learn only when they are taught. These teachers further understand that teaching their subject is a priority and prescribed by the education department. Knowledge is a flexible matter during teaching and learning, with teachers aware of what they are doing and why they are doing it.

Findings revealed that teachers, when responding to understanding of their roles, did not indicate whether they regard themselves as experts, facilitators, or researchers. Noteworthy is that teachers' responses during interviews and the focus group enabled me to categorise them accordingly. There is evidence in the findings that some teachers assume the role of experts as they are transmitters of knowledge, having authority over their learners in terms of how they manage their mathematics classes and the learning activities they expose their learners to. Both interview and focus-group results revealed that teachers understand that their role is to teach and expose learners to activities and experiences that promote learning of mathematics concepts and skills.

Teachers who have expert understanding of their roles are to teach the learners and ensure that learners learn; and this is achieved through developing the love of mathematics in learners as P1 maintained. P2 added that to make learners love mathematics, she leads by example by showing that she enjoys it herself, being creative, and also encouraging participation.

P1 said that *" I teach my learners…do class teaching and sometimes group teaching. teaching them in a group give them opportunity to learn from others…individual teaching not possible because of overcrowding. There is no time and space to provide support"*. These sentiments are held by P3 and P4.

These teachers regard their roles as those of transmitters of knowledge, believing that children learn only when they are taught. Past experiences as learners of mathematics when they were still young played a role in why teachers understand their roles the way they do. These teachers

do not believe in learners initiating their own learning and engaging in activities independently, with teachers playing the role of a facilitator. This is contrary to the understanding held by P6. He understands his role as that of a facilitator which is aligned with the competence curriculum and common understanding.

P6 "*I am a model, an assessor. I am not the driver, but the learners are driving me. I can plan what to teach but change the strategies due to but when I start to teach I observe the learners and their moods, then I may decide to change and accommodate them"*

Participants' understanding of their roles as teachers and transmitters of knowledge argue that this is not possible in their context, because the learners they are teaching do not want to think. The learners depend too much on what the digital world is exposing to them. They are unable to retain information they have acquired. One other challenge they cited is that learner-centred activities are difficult to execute as they have to rush through the curriculum with the little time they are afforded. Teachers continued to echo the challenges regarding content, relating them to how they affect their roles and teaching activities. The CAPS mathematics curriculum is too rigid; teachers reflected that it is very difficult to keep up with the allocated teaching time due to the reasons they provided. They opine that the structure of the content does not support their teaching strategies.

P2: *"The way the curriculum is structured, is not suitable for young learners. The pacing of content and allocation of time makes if difficult. Teaching more than one concept in a week; addition, subtraction, data handling, space. Yoh! It's too much. Children also don't have time to master concepts"*

P1: *"I recall over 30 years when I was teaching Grade 2, I wasn't under pressure to teach ten other things in a period of two weeks. I was able to concentrate on grouping my learners…we older teachers know that this is not working for our learners"*

The focus-group findings revealed that participants view their roles as constricted. They are assuming the current roles and ways of teaching mathematics which are different from the old methods of teaching; however, this is difficult for them because the learners are not learning. Teachers are more concerned about the limited time they have to teach all the content, which impacts negatively on their roles and on how they teach. Some participants took their understanding to a personal level, providing their individual understanding of why they maintain their roles and teaching and learning activities.

P5: "*I did not intend to teach foundation phase because of my school experiences. I, as a child…was always with a teacher who could not teach maths… and then children do not choose mathematics because there is no understanding. My role is to make children love maths"*

P4: *"I teach as we were taught in the olden days. The way we teach mathematics and the language of mathematics is still the same, but the generation is different"* this suggest that both P1 and P4 understanding their roles as the one of correcting learners' perceptions about learning mathematics. They capitalise on their and lessons learnt to support their teaching and understanding. These are their personal identity and individual understanding.

To sum up, teachers in this study added that, over and above the limited time allocated to mathematics, there is a need to accommodate learners with barriers to learning. This is a requirement stipulated in the foundation phase Mathematics CAPS: activities for these learners should be adapted in such a way that critical concepts and skills are not compromised in the process. The NPPPPR of the NCS Grade R-12 clearly stipulates "The time allocated to breaks, assemblies and extramural activities is excluded from the time allocation. Time must be made available to support learners who experience barriers to learning within the instructional time" (DBE, 2011c, p. 11). Furthermore, the learners need to be afforded more time to complete activities and tasks and to acquire thinking skills that will help them complete activities the easiest way they understand them (CAPS, 2011a). The implication of this statement suggests that the other activities in and outside the teaching time allocated impact the curriculum coverage, which is tightly monitored. Hence there are continuous complaints that the curriculum is overloaded.

The solution this study provides after engaging in the deliberations during interviews and reflections during focus groups is that teachers should be allowed to assume an independent identity when teaching their mathematics lessons. They should also be allowed to teach concepts the best way they can to enable learners to master such. Teachers need time to teach properly and to consolidate concepts taught. This will allow learners to remember and retain the information in their subconscious minds, retrieving it as and when needed, especially during assessments.

7.2.5. Assessment

As alluded to in the previous chapters, assessment is core and of central importance to education, and integral to teaching and learning in the formal school setting. Teachers and developers use

assessment to evaluate whether teaching and learning has taken place; and to determine whether the curriculum goals are met (Taras, 2005; Amua-Sekyi, 2016). It is therefore imperative for teachers to understand the purpose of assessment in their subject. When it is used to improve or alter teaching, it is called assessment for learning; and when it is used as a judgement, it is known as assessment of learning or summative assessment and this is how this study also classified them.

During interviews, participants acknowledged that they understand that in mathematics, they administer both formal and informal assessments as per policy. They also mentioned that they administer continuous assessment in Grade 3, using various forms of assessment.

P1: *"I assess my learners because we have to. I know assessment can be done orally or written to cover a diversity of learners."*

P2: *"After teaching, I have to know whether my leaners understood or not. I give my learners classwork and mark it. At the end of the week we, the three Grade 3 teachers, share our assessments that we did during the week, recap and improve our teaching. I also give them homework. …last week we did formal assessment…is a written assessment"*

P6: *"In terms of assessment, there are many ways to do the assessment… informal assessment and formal assessment. This is the one I am using now. The informal I do in my classroom when I am observing, for example, in mathematics when they count. They also do written activities. I give them homework also, but when they bring it back you see that it is not the learner's handwriting. Their parents do it for them. The problem is that this conceals the learners' understanding of concepts taught."*

The findings indicated that all the participants understand that in the foundation phase assessment is administered both formally (summative) and informally (formative). A number of them indicated that assessment in the foundation phase is continuous, which aligns their understanding with competence curriculum assessment. They are aware that informal assessment is to support and improve their teaching; and formal assessment covers written tasks. Due to their understanding of the two types of assessment and their ability to administer both in their classrooms, these teachers are combining the performance and competence curriculum strategies by using their personal understanding.

Their position regarding the informal assessments, which are also called formative assessment or assessment for learning is consistent with findings from literature that formative assessment

is mostly used as part of a learning process, to gather learners' information to improve pedagogy; to improve learner performance; and also as a diagnostic tool to assess the level of learners' knowledge and where teachers have to start teaching (William, 1999; Harlen and James, 2005, Ojuko *et al.*, 2013; Nortvedt, *et al.*, 2016; Rummanova *et.al.*, 2020).

There is also consensus in the findings from interviews that summative or formal assessment is administered to promote learners to the next grade. One may conclude that teachers are administering summative assessment, contrary to the mathematics CAPS prescripts. It is stated in the Foundation Phase Mathematics CAPS and the Foundation Phase CAPS amendments documents that teachers should note that "formal assessment tasks should not be seen as a single event or test. The task must comply with the principles of continuous assessment at all times. It is important that all grades include all forms of assessment, i.e., written, oral, and practical in each formal mathematics assessment task" (DBE, 2011a, p. 486; DBE, 2019, p. 7). The documents were shared with the participants after the interviews, and they were requested to go through them.

Despite having assessment guidelines, in addition, P5 questioned the issues of quality and fairness of assessment in the foundation phase.

P5: *"The standard of assessment has been impacted negatively by Covid-19. The other thing, assessment is not fair in the Foundation Phase. Teachers… do not teach and are absent from work, but their learners get abo-level 7 (Level 7s). They set a small task with many marks. Department is not fair on this one. We need old tests form province or national. These ones from schools make our learners not to know anything. That is why we have many progressed learners till matric."* In this account, P5 advocates for standardised national or provincial assessments as in his opinion, teachers cheat the process when administering summative assessments. During the focus-group discussion, the participants became more vocal about assessments.

P1: *"we have to do it and the amount of assessment and the variety that we need do not benefit children. The rubrics we use for oral assessments are so skewed. The weightings and assessment are structured they are giving parents false hope that their children are passing. I have children that I know should repeat the grade, but they are passing. The other thing is that teachers in the foundation phase do not teach well, then assessment becomes flawed."* P1 is echoing same concerns raised during the interviews, which she was not part of. She added that learners need to be assessed according to the skills. Assessment is on the skills these learners learnt, not how much content we taught to make learners learn. This will in turn assist the teacher to go back and

refine those skills. This participant's views are aligned with assessment for learning, which is aligned with the competence curriculum.

P3 *"Yeah, I agree with…I think we are doing assessment for the recording purposes really, because if you can check really, our learners are still struggling a lot, but we record as if they are perfect."* These accounts portray the flaws of the current assessment guidelines and the CAPS amendments.

P4 added that *"currently, we are killing the learners with assessments. Teachers are teaching to assessment because there is always an assessment to administer, whether it is a continuous assessment or formal task. In a week, two of the five days you are assessing, this is, if you want to meet all the expected standards of assessment."*

These teachers argue that the quantity of these tasks is overwhelming. Teachers have to conduct ongoing assessment, formal assessment, and diagnostic assessment at the beginning of each term; and there is no time for real teaching. Life in the foundation phase is assessment which creates a great deal of tension for both teachers and learners.

Furthermore, teachers contend that the assessment methods and tools make it difficult for them to manage learners who are not performing well in mathematics. The rubrics, for example, are passing learners who do not know anything. According to them, the old written weekly and monthly assessments were the best. The teachers blame the current situation on COVID-19 because they claim that all the changes came about during COVID-19 and still form a large part of the Learning Recovery Programme (LRP) that DBE has initiated. The LRP was developed by DBE to acknowledge that during COVID-19, there were learning losses that the system will not be able to recover. Learners were promoted to the next grade without acquiring the foundational knowledge needed for the next grade. Recognising the seriousness and urgency of this imperative, the Department Basic Education has devised a Learning Recovery (LRP) programme and the 2023 – 2024 Annual Teaching Plans (ATPs), effective from 2023 (DBE, 2023). This, therefore, puts too much pressure on teachers as their workload has increased. P3 added that *"…but with this continuous assessment that comes along…we teach, then three days later we assess. It's too much and when it comes to actual assessment learners don't even want to do it. Assessment should just be done once the children have grasped the concepts. Everything else is time consuming."*

The findings of this discussion were more on formative assessment. T general feeling is that these teachers see no value in administering monitored continuous assessment. Despite their

efforts, summative or formal assessment is also mandatory as learners have to be promoted to the next grade.

Findings regarding summative assessment are that the participants do things differently. The majority of participants during the interviews boldly indicated that their summative assessments are only written tasks. They did not consider other aspects either oral or practical, even though some concepts need to be assessed as such. Another reason for only administering written summative assessments is that the principals at their schools need to see a 'test', not to be told that learners are assessed using various assessment forms and tools. They regard that as laziness or defying authority. Teachers have been advised by subject advisors that formal assessments should not be a once-off activity. These assessments should be administered continuously to comply with assessment guidelines.

P4: *"I give them class activities to assess what I was teaching and this takes place continuously. There is time when formal assessment is needed and I am forced to set a written task only. The problem mam is that the principal does not understand when I tell her that we do not have to write everything, some need to be done practically and orally. Even when I show her the programme of assessment and the assessment plan, it is not accepted. There I have to listen and comply."* Other participants agree with her, but justify that it is actually a good thing for learners to write the test, as in the past.

Teachers also indicated that they are not sure about the quality because teachers present tasks differently.

P3: *"Assessments have to be age and grade appropriate. In some schools assessment is not age appropriate. The frameworks that subject advisors gave to us, are no longer applicable after Covid-19. It is better that we go back to writing common standardised assessment that the district was giving to us, or maybe they check our assessments if they are of good standard."* Other participants agreed, implying that those assessments reduced their workload and were standardised. They were able to assess themselves and their learners' performance against other Grade 3 teachers and performance of other learners in the circuit and district.

Before COVID-19, the teachers were provided with assessment frameworks I designed after the findings of the study I conducted on subject advisors' reflections on the implementation of the Grade 3 mathematics curriculum. The findings were that there is a need to improve assessments

in Grade 3. I therefore developed assessment frameworks for mathematics to be used in piloted circuits in the district. By the time I left the district, the frameworks had been implemented in over 10 circuits of the district. The frameworks were assisting teachers to set a quality task that covers all cognitive levels. After setting the tasks they submit it for quality assurance to check whether they had covered all content set for the term.

It was also found that teachers understand administration of assessment as compliance rather than a developmental process. They have to report to stakeholders, perform diagnostic analysis and account for learner performance. The participants find themselves simply ticking boxes and gathering numbers without remediation. Teachers argue that the curriculum does not provide time for remediation. If they provide such, they will miss the whole of the following week's ATP. Hence they prefer that they be provided with common formal assessments from the district, province, or national departments of education, which they think will be helpful for standardisation. In Galane's (2016) study, one of the findings on roles of subject advisors were that they provide guidelines on setting tasks, moderating school-based assessments; and they also set provincial and national assessments. This suggests that they are creating room for dependency by teachers, which cripples their ability to master assessment processes. The study proposes that there be an extended area of research focused on improving teachers' assessment skills. This exercise may not only serve as a developmental activity for individual teachers, but also as a peer assessment activity; teachers will be assessing their peers and learning from one another. This will also be promoting reflective activities as the teacher will be given the opportunity to look into their assessments, see what they have performed correctly, note what they did not do well, and create ways of improving. The improvement will also impact on their roles and how they teach.

Peer assessment is an area of assessment that this study did not manage because teachers are given the opportunity to reflect in a group on their practice. They did not present anything to be peer- (e.g., lesson plans, assessment task or their teaching of mathematics to their learners) assessed by other participants. Even in their teaching, they did not encourage or support such. During observations, it was only P4 who was observed promoting peer assessment during her lesson. Peer assessment is understood by teachers only as giving learners the opportunity to assess one another as peers. This study, however, envisaged that sometimes during the process of data generation, teachers may agree to assess one another's activities, assessments, and practice as reflected in the lesson study approach.

7.2.6. The learning environment and resources

The traditional concept of a learning environment is a formal school setting, with learners in the classroom facing the teacher and listening to the teaching. The learning environment is explained in simple terms by researchers as a place where teaching and learning takes place; and in this place teachers, learners, resources, and facilities effectively interact − one cannot function without the other (Adnan *et al.*, 2014, Pellegrino 2017; Ibem *et al.*, 2017; Mabuza, 2018). This study identified three categories of the learning environments − the physical learning environment, the online learning environment and the blended learning environment. These were discussed in detail in the previous chapters. Son & Hu (2014) remind us that the digital technology in education has featured heavily in the teaching and learning environments, even before COVID-19 struck. According to Khoza (2021b), in online teaching of the digitalised curriculum (DC), the learning management systems (LMSs) dominate the performance-based curriculum; whereas the social media sites (SMSs) dominate the competence-based curriculum. Some of the prominent LMSs − Blackboard, Moodle, Web CT and Facebook, WhatsApp, YouTube, and others are popular SMSs. Blended learning is an educational environment that combines face-to-face (F2F) education and DC; and it promotes personal understanding

In constructivist approaches, all three environments suffice for teaching and learning. The understanding of teachers is, however, that they should be able to utilise these spaces beneficially; and ensure that this does not marginalise other learners. Teachers in the study understand and are conversant with utilisation of the physical learning environment, which are the school and its surroundings. In Grade 3 mathematics, for example in the content area, space and shape, topic: position, orientation, and views; learners are taught the concepts of positions and directions. They should be able to "follow and give directions to move around the classroom and school" (DBE, 2011a). For this activity, teachers need to let learners explore their physical learning environment both inside and outside the classroom, which is what they understand about using the available environment.

When asked during interviews and focus group about their understanding of why they are using the learning environment they are using, all teachers provided their reasons. Of note, is that all teachers teach in a school environment.

P1; *"I teach at a school because at school we are guided by policy. It is safe, disciplined and motivational."*

P2: *"the school is a formal environment and more disciplined."*

All teachers provided the same responses as P1 and P2 with regard to the school environment. They all agree that a school is a place characterised by high morals, guided by policy, regulated disciplinary measures and where learners are safe. P4 added that when learners come to school, as teachers, they are able to help them identify challenges that they may be facing. During the focus group, teachers still held same sentiments regarding the learning environment.

P1: *"You know us, foundation phase teachers. We have to stay with our learners because you know, they are our babies and we grow them, but we need to be equipped to teach the mathematics."*

P4: *"We teach in a classroom with the person in front of us. A concrete, brick and mortar, building with desks and chairs if we're lucky. But the contextual factors of all the different schools in the country is totally different. In Foundation phase learning, we show them, we tell them, we demonstrate to them, we work with them, so the classroom is the best."*

P2, P3, and P5 agreed that the classroom is the best place for their Grade 3 learners. However, they cited that factors that impact the classroom environment negatively included ill-disciplined and ill-mannered learners, overcrowding, and unmaintained infrastructure. Teachers argue that it is difficult to work under these conditions. Ibem *et al.,* 2017; Sithole, 2017 & Mabuza, 2018 confirm that the learning environment influences the effectiveness of teachers and the motivation of learners. Teachers become effective in learning environments with buildings that are well kept, with furniture that is in good condition and in a well ventilated classroom. These findings reveal that teachers are comfortable teaching their Grade 3 learners in a traditional classroom, it being accessible to all learners. Learners were then probed further regarding the use of the online and blended learning environments, starting from the time of COVID-19. Online learning environments may be aligned with either performance or competence curriculum.

Participants 1 to 4 admitted that they were not able to use the online learning environment because they were not prepared. Besides being prepared, they had little or no skills in using the online learning environments. Challenges that they cited were lack of digital resources, and learners not having access to internet and gadgets. For these reasons, teaching and learning did not take place during the lockdown. These findings are consistent with literature that learners from compromised backgrounds did not benefit from the online teaching due to their poor socio-economic backgrounds. The situation was aggravated by teachers who also had limited or no

access to online platforms due lack of skills, no access to the internet or lack of resources Khoza and Mpungose, 2020; Mukute *et al.*, 2020; UNESCO, 2021; Alexander, 2022)

P4: *"People think if we don't have technology, we can't teach properly and that's not the case. If we don't have technology, especially with ESKOM right now, it tells us that whether you have a smart board or you have a blackboard, if Eskom decides to switch off, you're going to do old fashioned teaching."*

According to *P5*: *"Online teaching is not for everyone. During Covid-19, technology worked for some people and 90% of the people it didn't work for. Unfortunately, we are expected to achieve same outcomes, but the level, the playgrounds and on which we are playing is not the same. This is the reality of this country."*

The account of teachers makes it clear and supports their previous justification that the online learning environment worked for a few people only. Schools that suffered the most are those in the rural and some township areas. Other participants agreed and added that online environments and teaching are not suitable for foundation phase learners. Technology cannot replace the teacher in front of the learners. It is evident that the challenges put forth by the participants were common to South Africa and elsewhere, attesting to the challenges that teachers cited. Similarly, the researchers (An *et al*., 2021; Van Bergen & Daniel, 2022; Lucas & Vicente, 2022) posit that insufficient technological infrastructure, lack of technical equipment, digital skills, redesigning and setting up new learning scenarios were among the main challenges that were experienced across the globe.

These researchers pointed out that time management was also a challenge because teachers had to plan, readapt the teaching materials and familiarise themselves with the teaching tools to be used for online teaching. Should teachers experience technical glitches during the lesson, they were on their own without technical support. The success of utilisation of online teaching depended on teachers' knowledge and understanding of digital learning technologies and LMSs at their disposal. LMSs are learning environments that are aligned with the performance curriculum; teachers who use them have expert understanding of their learning environments, because they have been prescribed (Kiramba, 2020; Khoza, 2021a). Selection of resources is also informed by selected objectives, or content. Each learning environment, whether physical, digitalised or blended, is one of the curriculum determinants of which teaching and learning resources can be utilised in a particular subject. The most common teaching and learning resources that are used in a physical learning environment are concrete resources. With the

emergence of online or digital resources, teachers are now able to access digitalised resources by using Google, YouTube, and TikTok, to name a few.

The interviews and the focus group revealed that most teachers are more comfortable using physical or concrete resources. For all participants, concrete resources are regarded as the best. The challenge teachers are experiencing is that they are not supplied with a common set of resources to use in their mathematics lessons.

P3: *"I use what I have, paper,… straws, …toothpicks. Because it's simple practical resources that I don't have in my grade 3 class, which I would love the Department of Education to consider buying for us. If you want the knowledge to build across the foundation phase and to get the foundation stronger than what it is right now you need basic resources and most of the schools don't have the resources unless they have the budget for it."*

Contrary to P4, P2 argues that yes, resources are needed, and having more of them does not suffice for successful teaching and learning. The most important resources they need as teachers is time and to stop chasing after the ATP because learners are not learning that way.

P2: *"So, for me, … you know, we may have a lot of resources, but the problem is we are chasing this curriculum. Teachers are not using the resources anymore, so I only use it. Simple example of multiplication. If you didn't teach grouping and teaching it, … with the concrete apparatus as to how to form the groups of tools. And that's how, which leads up to multiplication. There are teachers that will be, you know, are cutting out that step and teaching multiplication because we don't have availability of time, they largest resource we need is time… I think we need to stop chasing this ATP and this umm, you know our curriculum coverage and we should actually focus on setting the solid foundation where we are given this concrete like this."*

When probed further regarding utilisation of online resources, participants, as in the previous chapter, maintained that their schools do not provide for them. They do have smart phones and since they started participating in this study they are able to access most of the online materials such as videos, worksheets, real-time activities to utilise. It was evident during observations, however, that they did not use them. This is because the study promoted the use of the digital platform and online resources. Firstly, I created a WhatsApp group that I used o communicate with participants, reminding them about our meetings. After the interview, I created a link with many online resources that they could access and use for their lessons; and to learn more about

the mathematics curriculum. I encouraged participants to download Zoom and Microsoft Teams; and provided some basic tutorials on how these platforms work. I shared some of my mathematics workshop recordings. All these served as motivation to the teachers who are also doing the same in their lessons.

P3; *"… I was afraid to use the internet because I did not know how. Now I am able to join your meeting on Zoom. For me this is an achievement. Eish, I feel so embarrassed because that time we did foundation phase course I was struggling and my children helped me. Now I can use it on my own"*

P1 *"I used to use my phone only for WhatsApp and calls only. I was always worried about data costs, but now the Wi-Fi helped me and I can see a lot of mathematics activities that I use with my children in class. The problem is that I cannot show them because my phone is small."*

P6: *"Mam. I know how to use the internet because I studied at university and sometimes we had to submit assignments online, but at school it is very difficult. What works for me now is that I called all the parents, and sked that those that are able, should allow their learners to access resources that I post on the group. We are improving mam, though some are still difficult."*

These findings corroborates literature findings in that with the introduction of online learning, teachers had fears and doubts; such were aggravated by lack of skills and support (Mokiwa-Ngubane and Khoza, 2014; Khoza & Mpungose, 2020; Agarwal *et al.*, 2021). The teachers in this study were also an exception. What the findings reveal is that the study assisted teachers to transform from being fearful of using the online environments and resources, incorporating them in some of their mathematics lessons. During focus group, teachers added that they have created parents' WhatsApp groups and are using them. They argued that WhatsApp is more cost-effective and accessible for most parents. They all agreed that this works for them most of the time. At this level, teachers have started to use their individual understanding, to produce individual understanding identity as they started using the blended learning environment and resources. According to Khoza (2021b), blended learning is a combination of the competence-based curriculum, which is societal identity for the common understanding; and the performance-based curriculum, which is the professional identity for expert understanding. These identities help teachers to develop their natural understanding identity if they can continue to gain more support. The study proposes that to nurture teachers' natural understanding, they need to be supported in the areas of weakness in their subjects.

7.3. Conclusion

To answer the philosophical 'why' question of this study, teachers provided reasons for understanding the mathematics curriculum they teach in a particular way. Findings of this chapter are a product of data generated from focus-group interviews and focus-group discussions. As presented at the beginning of the chapter, interviews and the focus group were discussed to find out why teachers understand the implemented mathematics curriculum the way they do. The findings were used to validate the findings from the two cycles of reflective activities and observations presented in the previous chapter. The findings were also used to determine whether this pragmatic action research contributed to improving teachers' practice and contribution to new knowledge. The teachers were able to reflect on their practice; based on the new understanding gained, they decided that their natural understanding identity was the most important identity.

The next chapter will, firstly, present the discussions of the findings on teachers' understanding. Then, emerging themes on teachers' understanding and their implications will also be discussed. Thereafter, possible contributions of this study to the body of knowledge will also be presented.

CHAPTER 8

SUMMARY OF FINDINGS, RECOMMENDATIONS AND CONCLUSION

8.1. Introduction

The objective of this pragmatic action research was to explore Grade 3 teachers' understanding of the implemented mathematics curriculum. The discussion of findings was based on data generated from reflective activities, observations, semi-structured interviews and focus-group discussions. Chapters Six and Seven analysed data to answer the two research questions of this study. The descriptive 'what' question was responded to in Chapter 6, whereas Chapter Seven answered the philosophical 'why' question. The first chapter presented how the South Africa national curriculum evolved over the years from the Apartheid regime to date. It then provided an overview of the mathematics curriculum, including the mathematics education that South African teachers and learners from different racial groups were exposed to pre-1994; and the possible implications this had on the current state of mathematics in South Africa.

Chapters Two and Three reviewed literature on teachers' understanding of the implemented mathematics curriculum. The two literature chapters established that there are two major divisions of understanding − the professional and the societal understandings (Shulman, 1986; Skemp, 1986; Ernst, 1989; Bernstein, 1999; Jansen, 2004; Schiro, 2008; Khoza, 2015a; Khoza, 2016a & b; Khoza, 2021a & b). This study classified the two types of understanding as expert and common understanding. Chapter Two presented teachers' expert understanding of the mathematics curriculum and Chapter Three presented the common understanding. Chapter 4 presented the NIF, which has been used as the frame of analysis for this study. It was in this chapter that the third proposition of individual understanding was determined, in support of the expert and common understandings. Khoza (2021 a & b), in the study that explored the migration to a DC at UKZN through the use of digital resources identified the third proposition as personal identity. The study argued that personal identity is in line with the pragmatic curriculum; and promotes reflections and critique such as who is teaching and who is learning. In support of the NIF and teachers' understanding of the implemented mathematics curriculum, this study produced the NUIF. This chapter presents the discussion of findings through themes; with three propositions of the NUIF, which are expert, common, and individual understanding of the implemented Grade 3 mathematics curriculum. The themes are rationale, goals, content, roles and teaching and learning activities, environment and resources, and assessment.

8.2. Theorising teachers' understanding through the natural understanding identity framework (NUIF)

Based on the findings of previous chapters, it would appear that some teachers are neither guided by their expert (professional), common (societal), nor individual (personal) understanding/identities. Hence Khoza's (2021b) observation that, humans, when engaged in some activities, they strive to achieve the best, however, when they fail to achieve due to some factors beyond them, they believe that nature is responsible for enhancing or driving actions in the universe. Therefore, their natural identity comes to play; and this is when they start re-reflecting and re-critiquing their practice. Therefore a pragmatic action research − the NIF − was used, validating its relevance to the current research on teachers' understanding; giving birth to the natural understanding identity framework (NUIF).

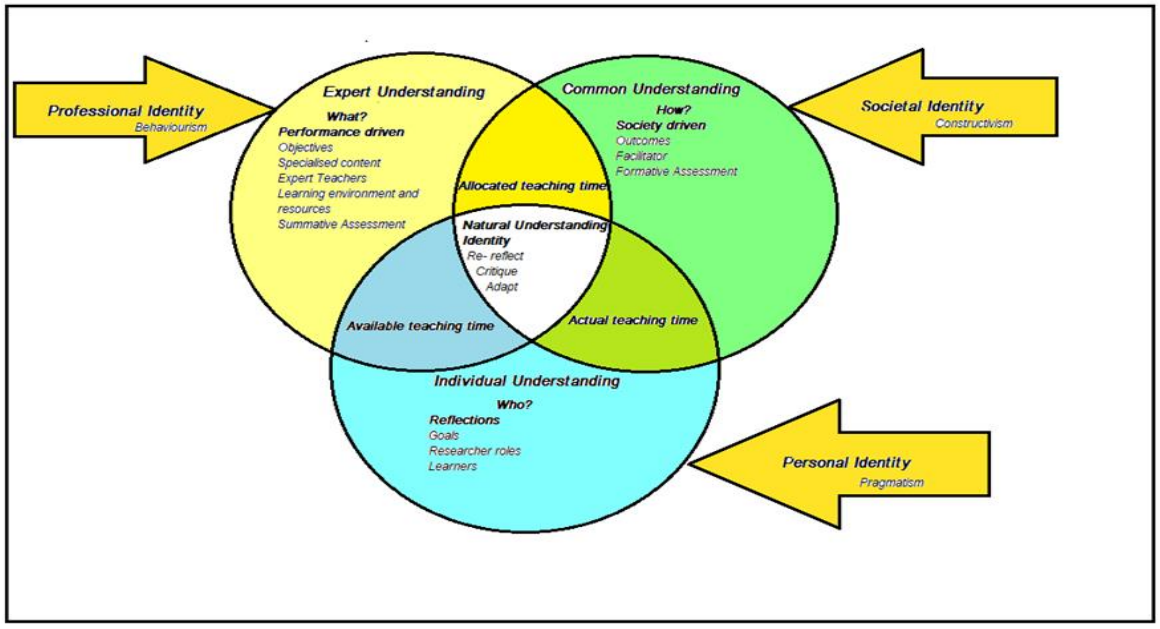


Figure 8.1. Natural understanding identity framework (NUIF)

As discussed in Chapter 4, the natural understanding identity framework draws its strength from the teachers' understanding as a phenomenon of this study, and from the themes of the natural identity framework (Khoza, 2021b). The original NIF applies summative assessment, peer assessment, and formative assessment as the connecters for each identity. This study has allocated teaching time, actual teaching time, and available teaching time as connecters. The reasons for connecting the themes to time allocation are that teachers in the reviewed literature cited challenges of time allocated for teaching mathematics as one of the challenges that impact teacher effectiveness.

The findings of this study are consistent with literature in that, while teachers grapple with their understanding identity, the time allocated for teaching mathematics is understood to be limited for the subject of this magnitude. Teachers with an expert understanding identity adhere to the allocated teaching time when planning their lessons, including assessments. Teachers using common understanding identities apply actual-time allocation, which is not rigid, but flexible. They do not follow the rigid time allocated for mathematics, but teach to the needs of learners or as there is availability of time. As per the findings of this study, actual time may be more or less than the allocated time for teaching mathematics in the foundation phase. For example, time allocated for teaching mathematics is approximately 1 hour and 30 minutes per day. However, it was observed during the teaching of lessons that none of the participants taught for that long. The longest lesson was about 50 minutes. Those who assume an individual understanding identity utilise whatever time is available to teach mathematics. They do not adhere to the allocated teaching time as per CAPS or the actual teaching time for the teachers who adhere to competence curriculum.

Hoadley (2020) maintains that in the lower grades of schooling, learners lost a third of the total school days in a year. Ardington *et al.* (2020) estimate the time of contact teaching lost to be about 50% to 60% due to school closures and rotational models, maintaining that the current losses have been underestimated. Gustafsson and Deliwe (2020) therefore recommend that the estimated learning losses be inflated by another 25% to mitigate the time lost.

It should be noted that these studies were conducted with the main focus on the 2020 and 2021 academic years, including reading in Grades 2 and 4. Therefore, reflective teachers need to use their personal identities and individual understanding to research and evaluate the actual losses incurred. This will be informed by their expert understanding of mathematics, their common understanding, and their experience of teaching mathematics. Teachers will have to utilise the available time maximally to advance improvement in the teaching of mathematics.

This process unfolds over time when teachers engage in reflections on their teaching practice. Also, the reform and innovations in curriculum do have an impact on the fluid nature of teacher roles. The other factor that impacts roles of teachers is the learners they teach, and the context in which they teach. These teachers ultimately use their distinctive understanding to navigate the

curriculum in such a way that benefits both them and the learners. At the same time this is in line with curriculum policy prescripts.

8.3. Teachers' natural understanding identity propositions

Findings in Chapters 6 and 7 revealed that teachers' understanding of the implemented mathematics curriculum, irrespective of their age and gender, are based on the curriculum demands. Teachers believe themselves obliged to comply to a T with what the authorities state must be done.

Initial study findings suggested that teachers' main understanding of their reason for teaching mathematics the way they do was their wanting to produce knowledgeable learners able to think creatively. Some participants indicated that they want to instill the love of mathematics in children, thus alleviating the fears that they had as learners of mathematics themselves. Research conducted on foundation phase pre-service and in-service teachers' views on mathematics teaching found that generally, foundation phase teachers have a fear of the subject. Such includes contact with mathematics, classes, homework, tests, and teaching the subject as qualified teachers. This fear continues in their teaching career as they, over time, develop low confidence in the teaching of mathematics. This attitude emerged from the findings: P4 indicated that she never enjoyed mathematics because in primary school she was always taught by incompetent teachers who often did not understand mathematics at all. My argument regarding the teachers' reasons for teaching mathematics is that they need to be given the opportunity to explore their expert, common and individual understanding identities, thus producing their natural understanding identities. I regard this type of understanding as innate to the teacher − each teacher will have a personal way of revealing this identity. When teachers realise their natural understanding identity, they will have a particular understanding of curriculum concepts and be able to adapt to what works for them.

8.3.1. Rationale

Literature (Berkvens *et al.*, 2014 and Jansen, 2004), Khoza, 2015b) presented what they found to be various reasons that determine why teachers each, and these reasons are also influenced by the expectations that the curriculum developers and policy makers have for teachers. Some teachers teach because of their own personal reasons, while other teach because they have been influenced by their environment and society. There are also those teachers who teach because they are qualified to teach and in addition, they have specialised in the subject they are teaching;

and that policy makers, when designing policies, have an ideal educator in mind. Reasons for teaching vary from personal/pedagogical, societal/social, to professional/content knowledge reasons. Khoza (2015b) maintained that the personal rationale is the core and main driver of common and expert reasons for teaching. Findings of this study indicated that teachers have various levels of understanding of their rationale for teaching mathematics. However, the expert rationale dominates the common and the individual. Teachers understand that in the foundation phase, the teaching of mathematics is not by choice or level of education − it is a compulsory subject. There are those participants whose rationale for teaching mathematics is founded on the prescripts of the mathematics curriculum. As this is a policy prescript or obligation teachers have no other option but to teach it. Teachers pointed out that they teach mathematics because it is a compulsory subject in the foundation phase. Research found that teachers' understanding of their rationale for teaching mathematics is mostly informed by the demands of the profession and the intended curriculum. Jansen (2004) argues that teachers ultimately work like technicians, racing to achieve the curriculum objectives.

Teachers who were driven by an individual rationale were open in their responses when justifying their reasons for teaching, freely offering their opinions. Their reasons included experience as a teacher, being a good teacher, being a hard worker, the love of the job and research conducted before studying further. Furthermore, their rationale included closing the gaps of their childhood fear of mathematics caused by the teachers who taught them. Therefore, these teachers' understanding was based more on individual understanding. Hence teachers' understanding of mathematics and mathematics teaching are greatly influenced by their personal experiences as learners themselves. Other factors that impact teachers' understanding and which later lead to challenges of implementation are insufficient time to prepare the mathematics lessons and its teaching thereof. When the curriculum, its resources and assessment change, this also impacts their understanding; yet teachers have no control over these factors. This then leads teachers to implement the curriculum the way they understand best.

8.3.2. Content

The findings of this study revealed that teachers have various levels of understanding of the prescribed mathematics content for Grade 3. However, even if their levels of understanding are different, teachers do not deviate from teaching this content. Another finding is that teachers do not rely on their level of education and specialisation in mathematics to be able to teach it.

Participants agree that the mathematics CAPS is a well-planned and organised curriculum; however, the content, concepts, and skills are too packed, especially since the introduction of ATPs. According to the participants, this makes it very difficult to cover content for each term. The implication is that if they do not cover content as prescribed, the departmental officials report negatively about teachers; then authenticity of performance of their learners is questioned. For a teacher who does not understand the connection between topics and concepts of mathematics, it is difficult to cover the topics and concepts as expected within the allocated teaching time. The NUIF proposes that teachers utilise the available teaching time to cover content of the mathematics curriculum during their everyday teaching.

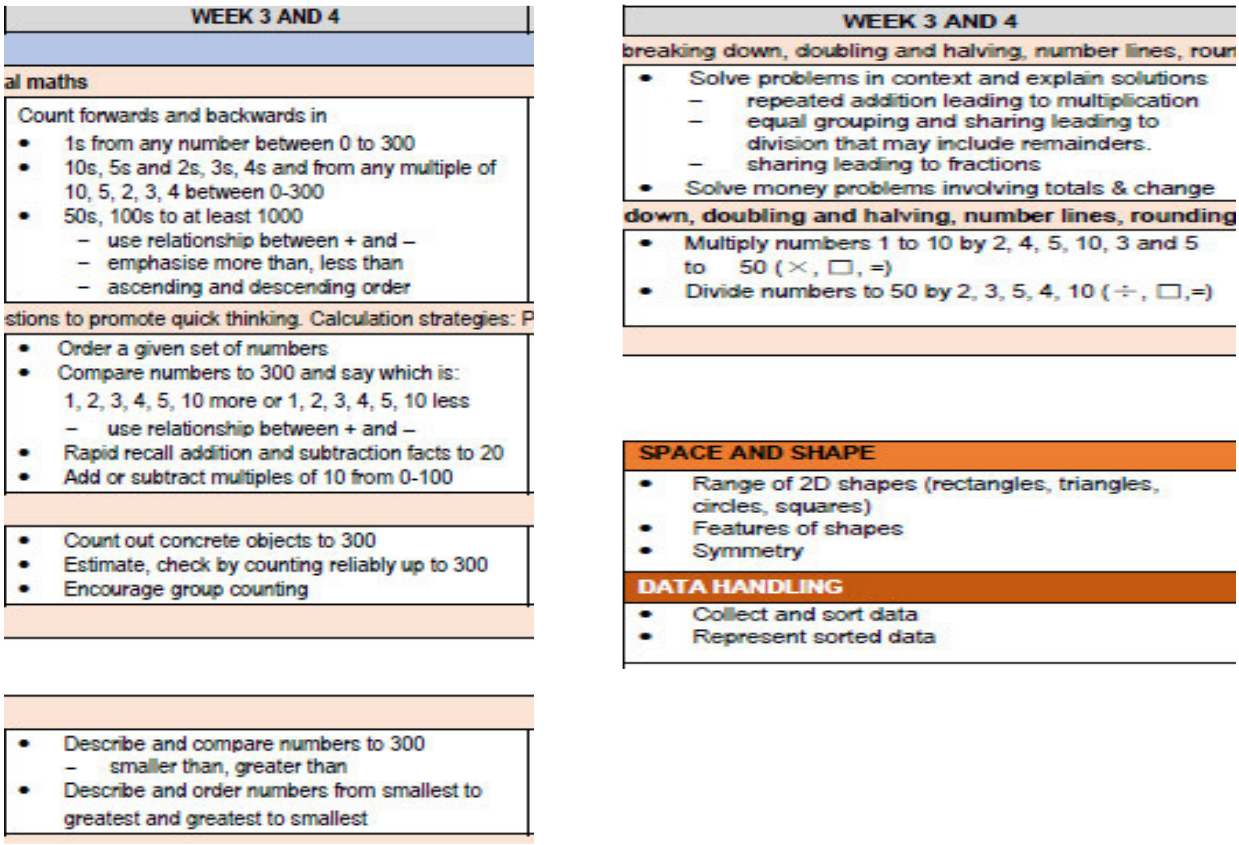
As the study is a pragmatic action research, participants had to be observed in practice when teaching the mathematics lesson. During lesson presentations, teachers were observed teaching more than one concept. This excluded the concept that had been planned to be taught formally for the day. Due to their teachers' stereotyped understanding of looking into the ATPs, selecting a concept to teach for the day, they could not realise that they were teaching more concepts unconsciously. For example, in P4's lesson, the teacher was teaching mass. Learners were taught to compare mass of different items using a balancing scale as a resource. In teaching this concept, the teacher covered estimation skills, number symbols, number names, and addition and subtraction. However, that was not recorded in her lesson plan. Skemp (1976) calls this instrumental understanding because the teacher and the teaching are based on a fixed plan of what to teach without deviation.

On the contrary, Participants 1, 3, and 6 also planned for the main concept to be developed in the lesson from the mathematics CAPS. What they did differently from P4 is that they integrated the concepts, and this was evident in their lesson plans. Integration is aligned with the competence curriculum which Skemp (1976) calls relational understanding. In their case, the teachers combined both the expert and common understanding identities, producing their individual understanding identity. According to Bernstein (1999) and Bajtoš (2016), teachers have both the vertical and horizontal knowledge of content, having both procedural and conceptual understanding of content. This could not be permanently contained and maintained, teachers having to re-reflect on the 'why' question.

It emerged from the findings that, as much as participants try to work hard thus keeping up with the demands of the system of education, they are dissatisfied with being pushed into teaching

mathematics, just for the sake of compliance; for this reason, they feel disempowered. Teachers acknowledged that mathematics CAPS is a good curriculum, but it has many limitations on their practice. According to the participants, these limitations are caused by the people who support its implementation. Firstly, the DBE came about with the ATPs that not only specify the core skills to be taught , but also during which week of the term they should be taught. Despite this being provided, the participants argue that it is not practically possible to teach more than one concept in a week, especially when the concepts are from different content areas. For example, this figure depicts content as spread over two weeks:

Tables 8.2 and 8.3: Grade 3 content to be covered in two weeks: Extracted from the 2023/24 ATPS (DBE, 2023)



WEEK 3 AND 4
al maths
Count forwards and backwards in • 1s from any number between 0 to 300 • 10s, 5s and 2s, 3s, 4s and from any multiple of 10, 5, 2, 3, 4 between 0-300 • 50s, 100s to at least 1000 – use relationship between + and – – emphasise more than, less than – ascending and descending order
stions to promote quick thinking. Calculation strategies: P
• Order a given set of numbers • Compare numbers to 300 and say which is: 1, 2, 3, 4, 5, 10 more or 1, 2, 3, 4, 5, 10 less – use relationship between + and – • Rapid recall addition and subtraction facts to 20 • Add or subtract multiples of 10 from 0-100
• Count out concrete objects to 300 • Estimate, check by counting reliably up to 300 • Encourage group counting
• Describe and compare numbers to 300 – smaller than, greater than • Describe and order numbers from smallest to greatest and greatest to smallest

WEEK 3 AND 4
breaking down, doubling and halving, number lines, roun
• Solve problems in context and explain solutions – repeated addition leading to multiplication – equal grouping and sharing leading to division that may include remainders. – sharing leading to fractions • Solve money problems involving totals & change
down, doubling and halving, number lines, rounding
• Multiply numbers 1 to 10 by 2, 4, 5, 10, 3 and 5 to 50 ($\times$, $\square$, =) • Divide numbers to 50 by 2, 3, 5, 4, 10 ($\div$, $\square$,=)
SPACE AND SHAPE
• Range of 2D shapes (rectangles, triangles, circles, squares) • Features of shapes • Symmetry
DATA HANDLING
• Collect and sort data • Represent sorted data

During the two weeks, not only is this content overloaded and a burden for teachers, but it is difficult to teach it in way that promotes learners' learning. This prevents learners from retaining and mastering one concept at a time, rendering them incompetent.

These reflections were important: Abdulhamid (2022) posits that, when teachers reflect, they start to realise that there are some obstacles that hinder how and why they teach. Through these reflections, teachers are able to improve their own practice and close the gaps. In this study, after

interrogating the content and identifying the challenges, participants expressed the need to be allowed to teach the way they know best that their learners will learn, without diluting or compromising content. The study therefore proposes that Grade 3 teachers be afforded the opportunity of using their natural understanding identity and available teaching time to complement the curriculum content requirements, without compromising quality.

8.3.3. Roles and learning activities

Evidence from findings revealed that teachers in this study understand their roles as transmitters of knowledge, the ones who know and must teach the learners who are envisioned by the DBE and society. Based on what content presents to them, the teachers preferred to use traditional ways of teaching mathematics, in which learners are to be drilled with one concept for at least a week or two to ensure that they master it. The mathematics CAPS does not prescribe how to teach, but it does prescribe what and when to teach. Therefore, I propose that reflective teachers, after adapting to what works for them to improve on their roles, be given proper support and opportunities to unleash their own understanding. This may assist them in teaching the way they believe their learners will learn best.

The participants' decisions to use the traditional teacher-centred approaches may be mistaken for their inability to use various teaching strategies. It has been found in research that teachers shy away from using various strategies when they are unaware of how to apply such (Jansen, 2004, Mohd *et al.,* 2010). The opposite is instead true in the context of this study because teachers do understand that the learner-centred teaching approach is important, albeit next to impossible given the context of their schools. The most prevalent of challenges are overcrowded classrooms and the learners' poor socio-economic backgrounds. Hence, we see teachers in this study indicating during the focus group that they implement and do what is best for their learners, using their own strategies to ensure that teaching and learning takes place. This is consistent with Euridyce (2008) and Khoza's (2021) argument that when the expert, common, and individual understanding and identity are combined and do not work, teachers engage in what does work. I therefore propose that teachers be allowed to be who they understand themselves to be − who they think they are.

8.3.4. Environment and resources

The learning environment was discussed in detail in Chapter 3; and this study declared the learning environment as a catalyst in the teaching and learning process. For teaching and learning to take place, there must be an enabling environment. The main activity in the specified learning environment is the interaction between the teacher and learners, and the learners and their peers. It has been established in literature that the learning environment can be either a real life, online, or a combination environment in which the two environments are melded. Depending on the type of learning institution, online environments can either be used to meet the demands of the professionals or for societal reasons.

Findings revealed that participants were more comfortable using the real-life learning environment, such as a school. According to them the school is the safest and most accessible environment for all learners. Teachers cited that at school discipline is maintained − there are certain rules to be followed. The school also complements the type of resources they are using; the findings indicate that the participants only use concrete resources. However, participants also cited challenges regarding overcrowding and the poor state of their classrooms, which they argue impact negatively on how they teach. Ibem *et al.*, 2017; Sithole, 2017 & Mabuza, 2018 concur that the state of the real-life learning environment impacts the effectiveness of teachers and the motivation of learners.

Based on the findings, participants do not use online resources; they did not use them during the Covid-19 pandemic. Amongst other reasons for not using them, is a lack of online resources enabling teachers to use the online platforms. The department did not provide teachers with support and resources for such. Teachers also have limited skills of using these online platform and resources. Lack of skills in using digital platforms, lack of support and resources, do not only affect teachers in this study. Studies conducted found that in many disadvantaged countries and communities, both teachers and learners have difficulty accessing these platforms due to lack of resources, poor connectivity, and lack of skills to utilise such assets (Mokiwa-Ngubane and Khoza, 2014; Son & Hu, 2014; Khoza & Mpungose, 2020; Mukute *et al.*, 2020; Agarwal *et al.*, 2021)

The only digital platform and resources that seem to work while accessible for P2, P5, and P6 is the WhatsApp platform. Teachers find this cost-effective and most used by many of the parents. Khoza (2021b) concurs that the SMSs are the most accessible as many people use them for

personal purposes. To date, WhatsApp has enabled teachers to communicate with parents, sharing some activities that learners can do at home. Because of the lack of digital platforms and resources, I propose that it should not be mandatory for teachers to use the blended learning environments. The Grade 3 learners, besides coming from poor socio-economic backgrounds, are still young to have and use gadgets such as cellphones unsupervised. Therefore, teachers should first orientate the learners on the use of these resources in their classrooms.

8.3.5. Assessment

Findings from literature and the generated data indicated that assessment is an important curriculum element because it is used to evaluate whether learning has taken place. It was also revealed from the analysed data that teachers know that assessment is important; moreover, they understand that when assessing learners in mathematics they assess them on what they have taught them. This is consistent with literature that teachers' understanding of assessment reflects that they also understand that the mathematics subject content taught translates the learning goals into subject objectives (Vandeyar & Killen, 2007; Adagale, 2015). The study also found that teachers use both formative and summative assessment. This was evident during observation when teachers were engaged in the teaching of a mathematics lesson. Of importance is that the participants understand that summative assessments are administered at the end of the term; and these assessments are used to determine learners' progress to the next grade.

However, when participants re-reflected, it was revealed that they have a challenge in understanding why it is demanded that learners be assessed continuously in the foundation phase. Teachers argued that continuous assessment is time-consuming − it takes most of the teaching time and places them and the learners under unnecessary pressure. These participants admitted that they are expected to set a formal summative assessment task, taking into consideration the cognitive levels according to Bloom's taxonomy. However, they do not have the capacity for this. Hence, the teachers' preference is to be provided with readily available common assessments set by district subject specialists. I argue that, as teachers have both expert and common understanding of assessment, they should be afforded a platform on which to share their assessment practices, peer assessing one another's formal assessments tasks. This exercise may be important in teachers combining their experiences and expertise in assessment.

8.4. Addressing the Research Questions of the Study

This study has been conducted to explore Grade 3 teachers' understanding of the implemented mathematics curriculum. Teachers' understanding was explored by asking the following research questions:

1. What are Grade 3 teachers' understandings of the implemented mathematics curriculum?
2. Why do Grade 3 teachers have a particular understanding the implemented mathematics curriculum?

To answer the two research questions, I reviewed literature on teachers' understanding in Chapters Two and Three. Furthermore, a pragmatic action research was conducted and data generated using reflective activities, observations, one-on-one semi-structured interviews, and a focus group. The findings are further based on existing literature, the curriculum concepts, and the themes of the NIF on teachers' understanding of the mathematics curriculum. The following section addresses the two research questions.

8.4.1. What are Grade 3 teachers' understandings of the implemented mathematics curriculum?

According to the existing literature, teachers have varying understandings of the mathematics curriculum: such impacts how they implement it. Understanding, as a phenomenon, has been classified in this study as either expert, common, or individual understanding. therefore, as discussed in the previous chapters; teachers' understanding may be influenced by either expert, common or individual understanding. expert understanding is aligned to the teacher's specialisation in the subject and teaching it following the curriculum prescripts (Skemp, 1976; Bernstein, 1999; Khoza, 2015a; Khoza, 2016). Similarly, the above researchers theorised common understanding of mathematics as an understanding that has its foundations on societal perspective mostly influenced by opinions and expectations of the society (Khoza, 2015a; Ngubane-Mokiwa & Khoza, 2016a).

Teachers who understand the curriculum from their individual understanding portray a combination of both expert and common understanding. These teachers, as they implement the curriculum, come to a realisation that the expert and common understandings do not work for them; or these understandings make it difficult for them to implement the curriculum as per policy prescripts or societal needs; they then portray individual understanding. Based on both types of these teachers' understanding, teachers are able to engage in reflective practice to evaluate which type promotes their individual understanding identity.

Literature and findings showed that teachers are more driven by the expert understanding of the mathematics curriculum: teachers always strive to ensure that they meet the subject objectives as stipulated in the mathematics CAPS. When teaching, teachers teach content that has been specially designed by curriculum developers and is regarded as the standardised content to be implemented across the country. This is consistent with findings of this study that some teachers understand that their role as teachers is to facilitate learning. Learners are to be given the opportunity to create their own meaning, adopting the constructivist approach to teaching and learning mathematics. This may be viewed as the ideal for the teachers; however, when they presented the lessons, the opposite was true. Teachers were assuming the role of instructors: teachers teaching and learners learning, aligned with the expert understanding. Teachers were observed making learners repeat after them and respond in a chorus. Another finding is that of their lack of understanding of formative/continuous assessment.

Evidence of common understanding was observed when teachers gave learners informal classwork activities after the lessons. In the way in which the activities were administered, it was clear that teacher used these to assess whether learning had taken place. These were formative assessment activities; they were set to improve learning. The set activities were regarded as an effective way of teachers improving pedagogy, supporting learners because they are part of the learning process (Khoza, 2015; Nortvedt *et al.,* 2016). Furthermore, the researchers argue that assessment for learning is aligned with the competence mathematics curriculum, and learner-centred approaches. Such provides the teacher with opportunity to cater for the needs of each student to be catered for individually. This is a view supported by Nortvedt *et al.* (2016) and Mabuza (2018) that assessment for learning works well for teachers who have a competence-orientated understanding of mathematics and it is aligned to learner-centred approach to teaching.

8.4.2. Why do teachers have a particular understanding of the implemented Grade 3 mathematics CAPS?

To answer this second research question, data was generated from interviews and the focus group; and findings were analysed and discussed in Chapter Seven. Findings revealed that teachers' understanding of the implemented mathematics curriculum was mainly based on expert understanding. The findings are similar to the finding from the first question, with the exception

that when the participants were probed, participants started to open up and reflect on their practice. When they reflected, it was discovered that there are inconsistencies in their practice, which is the teaching of mathematics and what they understand should be done. The participants realised that they mostly understood the curriculum as compliance with instructions; and that deviation in any way may place them at variance with authorities. When they started to reflect, teachers unleashed their individual understanding fully, in that they started to be fiercely vocal. Teachers presented their dissatisfaction with the current state of the mathematics curriculum in Grade Three; in the same breath teachers suggested what they believe would work for them.

Firstly, when asked what they understand to be their reasons for teaching, it was found that the majority of participants teach mathematics because it is a compulsory subject in the foundation phase. Again, teachers teach the subject because in the foundation phase they have to conduct class teaching − there is no specialist teaching of any given subject. Others indicated that they love mathematics and want to instil their love for the subject in their learners. Reasons for understanding why they teach were personal and unique to each individual. The common element was that mathematics is compulsory; issues were mentioned such as were they to have a choice, would they not teach mathematics? One participant said that she would prefer subject teaching so that those teachers who are more knowledgeable in teaching mathematics would be the ones to teach it.

The other aspect that came across strongly was the matter of content. All teachers acknowledge the mathematics content they have to teach; however, they are not satisfied by the packaging of the content into weeks as given in the ATPs. Firstly, teachers argue that there is limited time to cover the whole content per term. Secondly, the pacing does not support learners' learning of mathematics: the concepts and topic are mostly not connected in the short time of a week or two. After reflections teachers openly declared that they would continue to teach the content, but would rearrange and pace it to make it easy to teach and to suit their learners. Teachers also argued that the way in which content is packaged also affects administration of assessment.

As discussed in Chapter Two, the mathematics CAPS is content-centred and performance-based. Teachers have to formally (summative) assess selected content taught per term that will be recorded for promotion purposes. The challenges teachers cited are that the allocated time compromises the quality of these summative assessments. Assessments should be administered during time allocated for mathematics teaching. In addition, formative assessments should also

be administered continuously during the same allocated time. Findings are that teachers have resorted to assessing learners mainly on written tests, not considering other forms of assessments such as oral and practical. Teachers deem these assessment forms as time-consuming and as not being a true reflection of what learners have learnt. These oral and practical assessments, according to participants, allow learners who have not mastered content to pass. This is because the level descriptors and criteria on rubrics and on checklists are flawed. For this reason, teachers must have their individual understanding identity; driving the administration of assessments with their natural understanding identity.

It was also found that it is futile to enforce how teachers should teach, because subject advisors cannot be in all the schools at once to monitor implementation of content. teachers have had the opportunity and courage to affirm that they refuse to teach content as imposed; they are teaching as they used to teach in their early years of teaching. This move is not foreign. Dewey (1933) posits that when teachers reach this stage of reflections, they manifest their individual understanding of curriculum. This serves as evidence that they have been empowered with problem-solving abilities. When teachers reflect, they are able to determine the extent of impact their beliefs and how teaching have on the learners they teach (Moayeri & Rahimiy, 2019). Hence teachers explained that they understand that their role is to teach and to expose learners to teaching and learning that promotes learner-centredness.

Despite the teachers understanding that, as teachers of young children, they need to promote learner-centred pedagogies and support learners who have learning barriers; teachers openly declared that they would continue whole-class teaching strategies. Reasons they provided are that the learning environment and resources that they have do not promote such as required by the department. The classrooms are overcrowded, and teachers have limited resources. In support of teachers' challenges, there is consensus in literature that when teaching and learning take place in dilapidated and overcrowded classrooms, teachers and learners may easily become demotivated (Ibem *et al.,* 2017; Sithole, 2017 & Mabuza, 2018). These researchers opine that the class environment should afford learners and teachers opportunities to interact, cooperate, and to share opinions with one another. When teachers were asked why they do not improvise, they cited that the Department of Education or their schools should meet them half way. They should buy them basic mathematics resources that they can adapt where possible. Reasons for adapting resources are that these resources are written in English when their LoLT is an African language.

The NUIF promotes the natural understanding identity; for the purpose of closing the gap, this study proposes that the teaching of mathematics should not be confined to the four walls of the classroom. Teachers should be allowed to showcase their innate ability to teach without being put under pressure. For example, activities that involve addition and subtraction, multiplication, skip-counting, measurement, data-collection and sorting can all be conducted outdoors using natural resources and recyclable materials. Teachers can also teach by using popular indigenous games that promote learning of mathematical concepts. This allows them to cover procedural (expert) and conceptual (common) understanding of mathematics. This can be accomplished by using their individual understanding based on experiences and knowledge acquired in the past, thus producing their natural understanding identities.

8.5. Implications of the study in line with propositions

This study presented findings of the study on Chapters Six, Seven and Eight. The findings revealed that teachers' understanding is informed either by their expert or common understanding, or by a combination of both, which is the individual understanding of the implemented mathematics curriculum. Consistent with the findings of this study, Dlamini (2022) found that teachers are summoned by expert or common understanding of the curriculum to the extent that the individual understanding is less considered during the implementation of the curriculum. Of note is that these teachers are not aware of the types of understanding. It is mostly we, as researchers, who are able to determine whether the teacher's understanding is based on expert, common, or individual understanding.

Literature and findings of the study further revealed that the majority of foundation phase teachers are driven by expert understanding A combination of three propositions of understanding determines what teachers understand and why they understand the way they do. Therefore this study, based on the findings from literature and analysed data, concludes that there is no fixed understanding of the implemented mathematics curriculum for any one teacher. Therefore, I present some recommendations that are thought suitable to support teachers' understanding of the implemented mathematics curriculum. It is anticipated that these recommendations will embrace teachers' unique understanding identities for improved implementation of the curriculum. As suggested, these recommendations were informed by reviewed literature and findings of this study.

Firstly, it was revealed that there are policy and legislative frameworks that guide teachers in implementing the mathematics curriculum. However, interpretation of these policies, especially new innovations, is still a challenge, as teachers struggle to realise that they are the missing piece of the puzzle. The study revealed that teachers have, since the outbreak of COVID-19, received little or no support regarding all the changes that were effected by DBE on curriculum. For this reason, intensified curriculum support by foundation phase curriculum specialists or subject advisors is recommended to carry out this duty. There is evidence in literature that teachers who are well trained and supported are highly motivated, dedicated, and professionally competent. Khoza, 2015a; Galane, (2016); Soini *et al.* (2017) and Mabuza, (2018) concur that teacher development programmes, teachers' understanding and experiences enable teachers to interpret and implement the mathematics curriculum content as specified in the curriculum documents.

Secondly, teacher-development programmes, if any, do not address direct needs of teachers in practice. This was evident in the findings on teachers in this study. Teachers indicated that have not been trained to use online resources, let alone having those resources at their disposal. Therefore, teachers did not have resources and could not utilise them due to lack of IT skills. It is recommended that the district teacher development unit conduct focused in-service teacher training on utilisation of ICT resources for teachers' own learning; and also to support their teaching.

Again, the COVID-19 pandemic further aggravated the confusion that teachers were already having regarding assessment. Teachers' understanding of summative and formative assessments, including the purpose of each, was already flawed; then there was a string of circulars, i.e., *National Assessment Circular 02 of 2020: Implementation and Quality Assurance of the Amended 2020 Assessment Programme in the General Education and Training (GET) Band* (DBE, 2020a); *National Assessment Circular 3 of 2020: Implementation of Formative Assessment in the General Education and Training (GET) Band* (DBE, 2020b) and the recent *Circular S33 of 2022: Release of 2023/24 Annual Teaching Plans (ATPs), Including Revised Weightings to School Based Assessment and Examinations (Grades r- 12), Effective from the 2023 Academic Year* (DBE, 2022). The contents of these circulars have implications for curriculum implementation, as they address the revision of the ATPs from 2020 to date. The circulars also provide guidelines on how assessments have to be administered across the basic education sector. These circulars address the issues of programmes, plans, and weighting of assessments (school-based and examinations). Circulars are also loaded with relevant information to help teachers with curriculum implementation.

Based on these findings, the lack of uniformity in understanding critical information underpinning mathematics as a subject suggests that teachers may have had no access to these circulars. Even had they had access to this information, the information may at times have been overwhelming for teachers. Such becomes too difficult for teachers to comprehend without proper mediation. This may be compromising teachers' understanding of mathematics as a subject. To address content, subject-specific and assessment challenges, the department should develop and endorse assessment guidelines; or mandate schools to use the circulars in conjunction with the revised ATPs and the Amended Section 4 of the CAPS (DBE, 2019) per subject, these documents being comprehensive. The Amended Section 4 of the CAPS was due for implementation in 2020 just before the outbreak of COVID-19; proper mediation was not conducted because of the lockdown.

Because DBE has ceased to develop guidelines to close the curriculum gaps brought forth by COVID-19, it is recommended that teachers be afforded autonomy to develop curriculum resources that they are able to utilise, thus embracing their natural understanding.

Lastly, given the spread and expected pacing of mathematics content in Grade 3, it is recommended that teachers use available time to teach mathematics. Teachers can maintain the allocated time, but reduce repetitive mathematics content in mathematics CAPS.

8.6. Implications for Future Studies

This action research explored Grade 3 teachers' understanding of the implemented mathematics curriculum focusing on the concepts of rationale, goals, content, teaching and learning activities, assessment, learning environment, and resources and learners. As the concept of time was used as a connector of the three propositions of understanding, I argue that the impact of time on the implemented curriculum has not been dealt with satisfactorily. I therefore suggest that a further study be conducted to explore teachers understanding of the allocated mathematics teaching time in the foundation phase.

8.7. Conclusion

This chapter attempted to provide a summary of findings from literature discussed in Chapters Two and Three and from analysed and summarised data on Chapters Six, Seven, and Eight. Findings revealed that teachers' understanding of the implemented mathematics curriculum of all the six participants was influenced by either their expert, common, or individual

understanding. Their types of understanding were evident in the ways in which they responded to the reflective activities; also partly in their interviews. Responding to questions on content, from the outset, participants indicated that they use the mathematics CAPS and do not deviate from the prescribed content. This was also evident.

During interviews it was then revealed that teachers are no longer using the mathematics CAPS as is, but rely on the ATPs that have laid out content to be taught each week. It was revealed that, before answering the philosophical 'why' question, teachers were mostly understanding the implemented mathematics curriculum as a prescript. They forced themselves to blindly select content as is from the CAPS, topic by topic, which led to some content not being covered at the end of the term. This rendered their assessments not authentic. Analysis of their assessment practices revealed that teachers understand that they have to administer both summative and formative assessment. Teachers understood the purpose of each type of assessment. However, the study found that teachers do not view peer assessment as an important part of the curriculum.

When given the opportunity to answer the philosophical 'why' questions, teachers switched to a reflective mode. They were able to interrogate their understanding by reflecting and critiquing their own understanding. This made teachers realise that expert understanding and common understanding can be integrated to produce individual understanding of the curriculum. This was made possible by adopting the NIF which embraced the personal, societal, and professional identities. The study merged the identities with understanding to produce the NUIF framework of this action research. This framework proved that, when teachers engage in reflection and critiquing of the understanding, teachers use their individual understanding. Such leads teachers to produce their natural understanding identity, thus improving their practice

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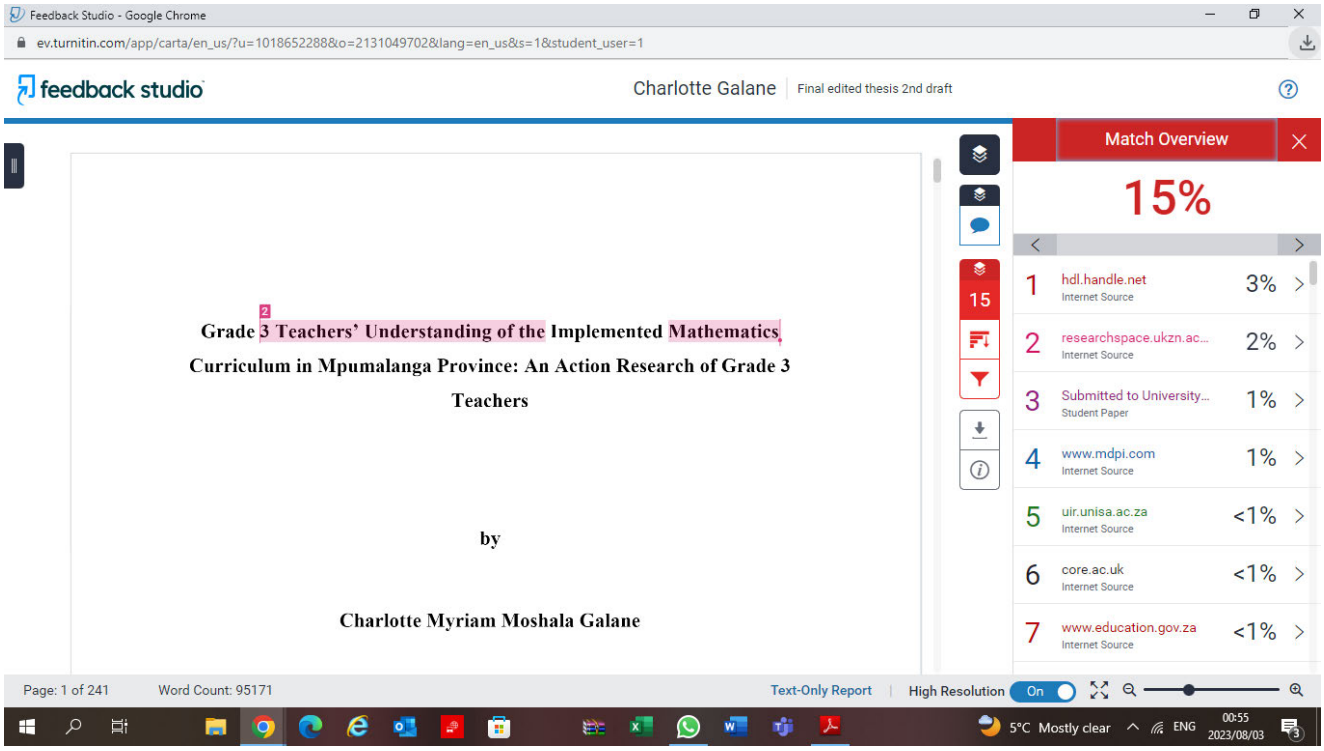
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