Exploring lecturers' interpretation and implementation of the intended NCV mathematics curriculum at a TVET college in KwaZulu- Natal Durban

By

Lungile Ngidi

200306336

A dissertation submitted in fulfilment of the requirement for the Degree of

Master in Education (Mathematics Education)

School of Education

Supevisor: Dr Themba M Mthethwa

2022

DECLARATION

I Lungile Ngidi, student number 200306336 wish to declare that:

The information in this dissertation, except where otherwise indicated, is original. This dissertation does not contain other persons' writings, data, pictures or other information unless specifically acknowledged as being sourced from other persons. Where other written sources have been quoted, then their words have been rewritten but the general information attributed to them has been referenced.

Signed Date: 27 January 2022

ACKNOWLEDGEMENTS

Firstly, I would like to thank the Lord Almighty who provided me with the strength, the protection, and the guidance thus far. I am delighted to acknowledge my late father iNkosi VM Shembe (IMISEBE YELANGA) who ordered me to do a Master's degree, because if it was not for him I would not be here. My sincere gratitude goes to my husband, Siyabonga Cyril Nduli, and my three children, Bandile, Makhathandwayo and Sikelela who allowed me to take their time and focus on my studies. I would not forget my late mother Thandi maSibiya Ngidi who hustled, and raised and moulded me to be the woman I am today. This research is attributed to these members of my family.

My sincere appreciation also goes to my supervisor, Dr. Themba Mngomeni Mthethwa, for his knowledge, wisdom, and patience that guided me through this journey.

ABSTRACT

The aim of this study were to explore lecturers' interpretation and implementation of the NCV Mathematics curriculum at a TVET college in KwaZulu Natal Durban. The researcher employed an interpretivist paradigm using a qualitative research approach so as to allow greater understanding of the lecturers' interpretation and implementation of the curriculum. Data was generated using document analysis and semi-structured interviews. Document analysis was carried out in order to determine what should be taught in NCV Mathematics classroom, and how it should be taught. The semi-structured interviews addressed questions about lecturers' understanding of the curriculum, their views about the purpose of the curriculum and the challenges they encounter implementing the curriculum. Due to COVID 19 pandemic, interviews were held online via Zoom. The analysis of the curriculum document revealed that NCV Mathematics curriculum is a structure of applied Mathematics, including problem solving and Mathematical modelling, with various contexts including real-life context. It is an integrated-type of curriculum that encourages learner-centred approach. The interviews have shown that lecturers harbour different views about the curriculum, where lecturers reported encountering challenges during its implementation. NCV Mathematics emerges as something unclear in terms of its purpose. Most of the lecturers argue that they don't understand the purpose or the intentions of the curriculum designers, since this involves aspects that are difficult for students.

TABLE OF CONTENTS

ACRONYMS

4IR	Fourth industrial revolution
Bed	Bachelor of Education
BSc	Bachelor of Science
DBE	Department of Basic Education
COVID 19	Coronavirus disease of 2019
DoE	Department of Education
DoL	Department of Labour
EIC	Electrical Infrastructure and Construction
ERD	Engineering and Related Designs
DHET	Department of Higher Education and Training
ECASS	External Continuous Assessment
FET	Further Education and Training
GET	General Education and Training
ICAS	Internal Continuous Assessment
KZN	KwaZulu-Natal
LO	Learning Outcome
NATED	National Education Department
NCV	National Certificate Vocational
NPDE	National Professional Diploma in Education
OBE	Outcomes-Based Education
RSA	Republic of South Africa
SONA	State of the Nation Address
TVET	Technical Vocational Education and Training
VET	Vocational Education and Training

LIST OF TABLES

LIST OF FIGURES

LIST OF APENDICES

CHAPTER 1

1. OVERVIEW OF THE STUDY

1.1 Introduction

The study explores the lecturers' interpretation and implementation of Mathematics curriculum at a Technical Vocational Education and Training (TVET) College in KwaZulu-Natal, Durban. If one is to analyse the NCV Mathematics curriculum, the focus should not only be on how policies are formulated, but also on how are they perceived, interpreted, and implemented. This study aims to establish knowledge about lecturers' interpretation of the NCV Mathematics curriculum, and their teaching practices implementing the curriculum.

This chapter presents the background and the context of the study, the problem statement, the study's motivation, objective and research questions, and the significance of the study. I further outline the structure and the organisation of the overall study.

According to Fejes, Nylund and Wallin (2019), teachers struggle to put curriculum content into practice, which can affect the quality of teaching and learning. This is mostly the case whilst a brand new curriculum is introduced. According to Phaeton and Stears (2016), there are many stakeholders involved at different levels of the curriculum that viewed and influence the curriculum, where influence has an important bearing on teaching and learning.

The quality and the success of implementing National Certificate Vocational (NCV) Mathematics curriculum depends on how the vision of the designers is interpreted and implemented by the lecturers. In this study, I focus on the design of the curriculum document, as well as the NCV Mathematics lecturers' interpretation thereof, so as to analyse how lecturers understand and transform the curriculum as set out in the curriculum document. Fejes, Nylund and Wallin (2019) have noted that what is on the curriculum document is always put on action by teachers who are the implementers, and when the

implementation take place, many stakeholders are involved and can change the original idea.

1.2 Background and the context of the study

South African TVET colleges have adopted a structure to suit the requirements of the apartheid and post-apartheid state (Van der Bijl & Lawrence, 2019). According to the White Paper 4: Department of Education (DoE) (1998a), TVET colleges have a mission to respond to human's needs for personal, civil and economic development.

A major investment in the future of artisans and South African people is a reformed, flexible and quality TVET system (White Paper 4: DoE 1998a). It objective should be a provision of education and training for students who want to take a vocational route (Lawrence, 2017). TVET colleges cater for skills in engineering, business, agriculture, information technology to develop the South African economy. Students enrol in TVET colleges purely to achieve the knowledge and skills required for work.

South African education policies have three education categories: The General Education and Training (GET) catering for primary school education, Further Education and Training (FET) for secondary school education, and Higher Education and Training (FET) for university and colleges (DHET, 2012). Initially, TVET colleges belonged to the FET band, but were later relocated to Department of Higher Education and Training (DHET, 2012), due to the fact that they were dealing with post-school programmes.

In the TVET sector, there have been many educational reforms from Technical Colleges to Vocational Education and Training (VET) in order to Further Education and Training (FET) and the Technical Vocational Education and Training (TVET) (DHET, 2014). Technical Colleges were declared FET Colleges in 2003 (Provincial Gazette, 2014). At the launch of the departmental White Paper on Post-School Education and Training on 15 January 2014, the DHET Minister, Blade Nzimande, announced that all FET Colleges should change to TVET Colleges.

The White Paper for Post-School Education and Training (2013) asserts that the primary motive for the establishment of such sectors was to provide training for the mid-level skills required to develop the South African economy and tend to concentrate on occupations in the engineering and construction industries, tourism and hospitality, and general business and management studies (White Paper for Post-School Education and Training, 2013).

TVET Colleges are obliged to offer quality education and training geared towards meeting the economy's needs and global standards. A successful TVET system must provide a diverse range of programmes that advance the knowledge, skills, attitudes, and values that South African needs as individuals and citizens, as lifelong learners, and as economically productive members of the society (DoE, 1998a).

Since 1994, the TVET College sector has experience extensive changes, the most significant of which being the amalgamation of 150 technical colleges into 50 multi-campuses. The mergers were based on physical location, which meant that colleges were to be in the same geographical area and resource allocation. Secondly, for each TVET college, councils were formed. These college councils are responsible for developing strategic plans, mission statements, and acquiring substantive strategic planning. Thirdly, the FET College Act of 2006 endorses that the government will appoint management staff, while all other staff, including lecturers, will be employed by the college council. Finally, an NCV programme was introduced.

Government Gazette No. 28677 (2006) announced the phasing out of the N1 to N3 national certificate (for engineering qualifications), which created a substantial decrease in the number of qualified artisans in different occupations needed in South Africa. According to South African Skills Development Amendment Act (2012), “an artisan is defined as a person who has been certified as competent to perform a listed trade” (p.16). A trade is defined (Republic of South Africa [RSA], 2012), as an occupation wherein a qualified person applies a high level of practical skills ,supported and re-enforced by underpinning and applied knowledge to manufacture, produce, service, install, or maintain tangible goods, products, or equipment in an engineering and/or technical work environment; uses tools and equipment to perform duties; measure and conduct fault-finding in processing

manufacturing, production and/or technical machinery and equipment to apply corrective repair actions; and apply and adhere to all relevant health and safety and environmental legislation.

In 2006, the DoE had a task to develop a learning programme that would provide learners with skills. The NCV Level 2(L2) to Level 4 (L4) was introduced with the intention to replace N1 to N3. According to the Department of Education (DoE, 1998b), the NCV programme was designed overcome the outdated division between "academic" and "vocational" education and training and is characterised, by a solid foundation of general knowledge combined with practical relevance rather than vocalisation. However, due to industry rejection and implementation challenges, the NCV had a lesser impact on artisan development.

The NCV was a vocational route to completing the National Senior Certificate (DoE, 2007). NCV is a learning programme of three years, starting from National Quality Framework (NQF) L2; L3 up to NQF L4. The Implementation of the NCV Curriculum was undertaken to address issues of scarce skills, furnishing learners with the necessary knowledge, practical skills, and understanding to apply what they have learned in the workplace.

The NCV programme offers a variety of vocational study fields. It integrates theory and practice (60% practical and 40% theory of the internal assessment) and provides students with a broader range of knowledge and practical skills within a specific industry field. The NCV curriculum is the combination of generic skills and job-specific orientation. There are seven subjects in all, with four vocational, and three fundamental (English, Life Orientation, Mathematics, and Mathematics Literacy). The NCV curriculum's implementation promoted simulation and practical work experience to complete the NCV level 4 (Powell, 2014). The entry requirement is NQF level 1 or Grade 9; assessments are in the form of Internal Continuous Assessment (ICASS) and External Continuous Assessment (ECASS) that contribute to a student's final mark. The pass mark for vocational subjects is 50%, fundamental: English, Life orientation is 40%, and Mathematics and Mathematical Literacy is 30% (DHET, 2018).

In view of the above, this study aims to analyse the curriculum document, so as to determine what type of curriculum it follows, and what teaching practices it promotes. Moreover, it aims to explore lecturers' interpretation of the curriculum whether or not lecturers adhere to the curriculum.

1.3 Problem statement

Most TVET lecturers teach without a professional teaching qualification. Some of them come from the industry, others from teaching, with no industry experience, while others derive straight from traditional universities, University of Technology, and TVET colleges. From a pedagogical point of view, this situation triggered an interest in determining how lecturers with diverse qualifications backgrounds and educational skills effectively interpret and transfer skills and knowledge within the Mathematics curriculum.

During the PricewaterhouseCoopers (PwC) Annual Report for the Higher Education held in Cape Town on 10 September 2019, Minister Nzimande noted that the Post School Education and Training curriculum remained critical if the country's economy needs to grow and meet the National Development Plans (NDP) objectives (DHET,2019b). Drawing from my experience and involvement in the TVET sector, there are mixed views about the NCV Mathematics curriculum. Some of the lecturers feel that NCV Mathematics is difficult for the type of students they are teaching; and they don't understand the purpose of the curriculum, whether it for the vocational stream or the academic stream. Hence, this study aimed to examine the curriculum, and how the lecturers interpret and implement it. In view of the above, the study aims to fulfil the objectives indicated below.

1.4 Objective of the study

The purpose of this study is to explore lecturers' interpretation and implementation of the NCV Mathematics curriculum at a TVET college. The study is guided by the following objective: to explore lecturers' interpretation and implementation of the intended NCV Mathematics curriculum at a TVET college. In this regard, the study has the following sub-objectives:

(a) to critically analyse how the NCV Mathematics curriculum is designed and structure; and

(b) to establish how lecturers', interpret and implement the curriculum.

1.5 Research questions

The research was guided by the following research questions

(a) How is the design and structure of NCV Mathematics curriculum?

(b) How do lecturers interpret and implement the NCV Mathematics curriculum?

Each research question provides direction, managing efforts, and choosing the suitable and proper approach to understand each phenomenon of interest (William, 2007).

1.6 Motivation for the study

During this critical period in the South African economy and the shortage of scarce skills, the government has invested a great deal in education. Since 2006, a large amount of money has been invested in the TVET sector in particular, with R1.9 million invested in 2006; R2,5 million invested in 2012; and R17,4 billion invested in 2013 (DHET, 2014). According to Minister Nzimande's debate on State of the Nation Address 2019 (SONA), since 2009, the government introduced the National Student Financial Aid Scheme (NSFAS) in TVET Colleges, with an amount of R100 million, and by 2018/19, this amount has increased to R5 billion (DHET, 2019a). Given the above figures, it is of best interest to explore what is happening within the sector. From my experience of teaching Mathematics,

it is hard to tell whether the TVET colleges meet the country's expectations, given degree of investment in the sector.

According to the 2014 Statistics on Post-School Education and Training in South Africa report from DHET, 166433 (23, 7%) were NCV Level 4 students, who passed in 2014 were able to successfully complete their qualification in that year, but only a small percentage, when compared to those at other levels. Seventeen percent of NCV students who wrote exams that year failed Mathematics (DHET, 2014). These figures can hardly correspond with a large amount of money invested from DHET. The latest available statistics shows that in the year of 2016, in Level 2, only 44% passed Mathematics and completed the level, in Level 3 it 45.8, and in Level 4 it 34,8% (DHET, 2017).

The research done so far played a central role in building and restructuring the TVET sector. Powell and McGrath (2014) argue that so-called productive approaches, which reflect economic growth and income generation, have so far dominated research in the sector as a critical development objective. These approaches reveal very little about the NCV Mathematics curriculum. TVET research globally has focused on system development, thereby neglecting teaching and learning (Powell & McGrath, 2014). For this reason, this study examines the curriculum and teaching of the curriculum.

1.7 Significance of the study

The former DHET Minister Naledi Pandor's opening remarks at the 9th Pan African TVET Colleges conference on 18 October 2018 alluded to the fact that that new training demands and changes will confront technical and vocational education in the next five years. South Africa is in the process of modernising and strengthening TVET colleges and their role in skills development.

The importance of a TVET sector in creating high-level knowledge generation and skills development for academia and technical quality requirements, has triggered an interest in

pursuing research within the sector. Having served in the TVET for nine years, and during the early years of the inception of NCV, I developed an interest in understanding the Mathematics curriculum. It is by now a truism that the country's economic growth requires Mathematics as a vital subject.

Markers' report in DHET 2013 confirmed that students experience Mathematics as a severe challenge. Improper implementation of Mathematics in TVET colleges has led to poor performance, as well as a high retention rate, and high dropout rate (Mofokeng, 2018). From my experience and sharing information in subject meetings and marking centres, poor implementation of Mathematics has been associated with low throughput rate. The throughput rate is the number of students completing a module, divided by the original number of students enrolled. This calls for an exploration of the Mathematics curriculum.

Research plays a vital role in enlightening curriculum developers, stakeholders and all that involved about the challenges and success of the intended and implemented curriculum. The study aims to explore the interpretation and nature of the curriculum's implementation through the lecturers' interpretation. The findings will provide necessary insight into the challenges of NCV Mathematics implementation, and it raises issues that point to the need for further research. It thereby contributes to existing knowledge about NCV Mathematics curriculum and wider discussion on the interpretation and transformation of the curriculum within the TVET sector.

There is not enough research conducted in NCV Mathematics. Hence, there is little available literature on the subject. I was motivated to conduct this study in an attempt to fill this lacuna. I believe that this study plays a significant role in assisting lecturers lecturing NCV Mathematics, adds to the body knowledge of the NCV Mathematics curriculum, and is useful to policymakers.

1.8 Definition of key terms

The following operational terms guide the study:

TVET College - is public institutions where students gain knowledge of a specific range of jobs or entrepreneurial opportunities.

Curriculum- Central guide for lecturers as to what is essential for teaching and learning NCV Mathematics (National Certificate in Vocational Mathematics).

1.9 Outline of the study

The study consist of five chapters as follows:

Chapter 1 presents the introduction to the study, its background and context, problem statement, the objectives, research questions, motivation to the study, the study's significance, and definition of key terms and outline of the study.

Chapter 2 is organised into two parts, that is, Part A, the literature review, which covers, TVET curriculum, NCV curriculum, and Mathematics curriculum, the Mathematics curriculum, and implementation. Lastly, Part B of the framework and its relevance to the study, which covers a theoretical and analytical framework.

Chapter 3 explains the research design and methodology used in the study, the research approach, the data collection method, and sampling procedures.

Chapter 4 entails data presentation, findings, and analysis of data.

Chapter 5 presents a summary of the study, recommendations, and conclusion of the study.

1.10 Conclusion

In this chapter, I presented the introduction into the study in which the background of the study, motivation, significance of the study, objectives and the research questions of the study were presented. Furthermore, the key terms were defined, and the outline of the study was presented.

In the next chapter, Literature review and theoretical framework for this study will be presented.

CHAPTER TWO

2. LITERATURE REVIEW AND FRAMEWORK

This chapter is organised into two parts, that is, Part A Literature review and Part B Framework.

Part A: Literature review

2.1 Introduction

This part describes the literature relevant for this study by presenting the previous research and current knowledge in the NCV Mathematics curriculum and Mathematics curriculum implementation. Discussions will concern the TVET curriculum, NCV, and Mathematics curriculum interpretation and implementation. In the context of curriculum interpretation and implementation, most research and studied, particularly in South Africa, argue about teachers' interpretation and implementation of the school curriculum. However, the content is relevant to TVET colleges. Therefore, the terms lecturer and teacher will be used interchangeably.

2.1.1 What is a literature review?

Rowley and Slack (2004) note that all research should be based on existing knowledge of the subject area, and literature reviews should identify and systematise concepts in the relevant literature. The purpose of a literature review is to summarise what is relevant in that subject area. Hart (2018) concurs with Rowley and Slack (2004) that a literature review involves scrutinising ideas, discovering the relationships between those ideas, and understanding the argument in the research.

Hart (2018) states that the literature review is the selection of available documents (both published and unpublished) on a topic that contain information, ideas, data and evidence

written from a specific point of view on the subject's nature, research methods, and topic, evaluating documents effectively in relation to the study. Gall, Borg and Gall (1996) note that the literature reviews serves to explain research questions, find new research directions, avoid reckless approaches, gain methodological understanding, identify recommendation for further research, and seek support for foreground theory.

2.1.2 TVET Curriculum

Curriculum is the most fundamental structure of the educational experience and is a kind of framework that defines the nature, form and direction of learning in the global education system (Houang & Schmidt, 2008). According to Van den Akker, De Boer, Folmer, Kuiper, Letschert, Nieveen and Thijs (2009), curricula may refer to an international curriculum (SUPRA), a national curriculum (MACRO), a school/institute curriculum (MESO), or a learner curriculum (NANO). Further to these levels, curricula may be represented by three main layers, namely the intended, planned or prescribed curriculum, which is a framework/written policy of ideas that are framed by educational/theories and intentions of teaching/learning that specify the intentions of the curriculum (Khoza, 2015b). The second layer is the implemented, enacted, or practised curriculum, where teachers interpret the perceived proposed curriculum and the actual learning process. (Khoza, 2015b). The third layer is the attained, achieved or assessed curriculum, which refers to the learner's perceived learning experience as measured by learning outcomes.

Post-apartheid structural and curriculum changes were intended to ensure that racial groups denied or restricted access to education and training have equal access to education and training (South Africa, 2008a). Loyness (2016) notes that TVET colleges constitute the main institutions of training for artisans. Mpondomse (2016) point to the fact that the TVET system plays a role in solving the problem of unemployment, which contributes to the broader goal of socio- economic change.

Albashiry, Voogt and Pieters (2015) assert that there is no general understanding of the concept of curriculum. The TVET sector recognises curriculum concepts as the construction of structured theory, practice, and operational learning mechanisms (DoE, 1998b; Agrawal, 2012, RSA, 2016; Terblanche & Bitzer, 2018). Its goal is to prepare students for specific or broader career by providing relevant industry knowledge and skills that will enhance employability (Wadekind, 2008; Terblanche, & Bitzer, 2018).

These authors characterise the Government's objectives as aiming to empower students with artisanal skills to contribute to the fragile South African economy. The media has made it abundantly clear that the South African economy is burdened with an oversupply of low-level skills. The essential mechanism to address skills shortage and unemployment in South Africa is the TVET sector. However, Gamble (2006) has a different view, and argues that VET's orientation towards preparing learners for the world of work demands a vital vocational element. Drawing from Basil Bernstein's (1999) work, she has argued that this has historically resulted in a narrow curriculum, focused on transmitting work skills at the expense of theoretical understanding. She further explains that knowledge must be given high priority in the vocational route in the general academic course. Nonetheless, knowledge also has to be linked to practical work experience in order to give the vocational pathway specificity. She has warned that the vocational route's promise leads to employability, and offering opportunities for further study would not be practicable (Gamble, 2006).

When the government revitalised TVET colleges, challenges, such as the low production of artisans, high failure rate, and high attrition rate were never anticipated, which are factors that increasingly contribute to youth unemployment. Attrition refers to the dropout of the students in the college, due to different reasons. According to Rienks and Taylor (2009), attrition is defined as the practice of students departing the school due to institutional structures and procedures. Buthelezi (2018) confirms Gamble's (2006) warning by revealing that the NCV curriculum was rejected by industries, and potential employers of the college products. The introduction of the new curriculum was not popular, due to a lack of communication with industry (Buthelezi, 2018). Research conducted by

Zulu (2018), Klaus (2016), and Pillay and Ngcobo (2010) confirms that the dropout rate in the TVET colleges emanates from the fact that students are dissatisfied with the courses offered by the college. They are not effective in achieving their career goals. Moreover, they are unemployed.

Statistics South Africa (Stats SA, 2018) has revealed that in the 2018, data shows that university graduates have the lowest unemployment rate in the country. In the first three months of 2018, 7.9% of graduates were unemployed. StatsSA classifies a graduate as someone who obtained a post-higher Diploma or honours from a traditional university or university of technology, Master's, or doctoral degrees. By way of comparison, of people with a tertiary education, 15.6% were unemployed. These people attended TVET colleges or other tertiary institutions and received a Certificate Diploma (with or without a certificate of admission), or a higher diploma. Table 2.1 represents the unemployment rate by education level in South Africa (Quarter 1:2018).

Table 2.1: Unemployment rate by education level in South Africa (Quarter 1:2018)

Education level	Unemployment rate
Without Matric	31.1%
With Matric	28.2%
Other post school education	15.6%
Graduate	7.9%

Source: Statistics South Africa's Quarterly Labour Force Survey (Quarterly 1: 2018)

TVET institutions lack the skills to lead effective curriculum development practices, resulting in untargeted academic disciplines, and are burdened by out-dated curricula (Albashiry et al., 2015). Shakizah (2016) concurs that learning materials in TVET colleges are exhausted, and inadequate.

The broader literature also shows that TVET curriculum development is placed at meso- and micro-college levels in order to promote flexibility and industrial responsiveness (Van

den Akker, 2003; Carl, 2009). However, the national authorities play a central role in providing educational policy development for TVET provision (Kessels, 1999; Marsh, 2009). There are concerns that with the rise of service work at the macro-level internationally, where the traditional focus of intermediate vocational institutions on technical skills has decreasing relevance (Kraak, Petersen & Boka 2016). There are concerns that employment across the formal sector is declining, or lagging economic growth (Kraak, Petersen & Baka, 2016). The TVET curriculum content must be kept relevant to the labour market's needs through regular research, review, and industry involvement supporting curriculum development (Clark & Winch, 2007; Kraak, Parterson & Boka, 2016).

2.1.3 NCV and Mathematics curriculum

The curriculum used to provide vocational education in South Africa is NCV, which combines generic skills with a job-specific orientation. The NCV curriculum has 17 fields of study over three years of full-time enrolment. It consists of vocational subjects designed for the occupation area and three fundamental subjects (Life orientation, English, Mathematics, and Mathematics Literacy). Students enter the world of work as artisans and technicians. There are three engineering streams: (1) Electrical Infrastructure and Construction (EIC); (2) Engineering and Related Design (ERD); and (3) Civil Engineering. The International Engineering Alliance recognised the qualification as the minimum standard of competence that a person must demonstrate in a particular field of practice in order to meet the standard of an engineering technician. Added to this is the importance of Mathematics and life-long learning (Amoo & Swart, 2018).

The National Skills Development Strategy III (DHET, 2012) emphasises that the skills shortages that South Africa faces in the craftsmanship, skills, and expertise is hindering the development and growth of our economy. Critical areas of economic growth targeted in the National Development Plan (NDP) include establishing a competitive base of infrastructure, producing sufficient energy to support industry, and access to clean water.

The engineering field is placed at the core of the economic growth and foregrounds the NCV engineering programmes as crucial in supplying the artisans required. All NCV engineering courses have Mathematics as a compulsory subject that deals with measurements as a broader concept. It involves the application of measurement skills, and it features prominently in the mathematics curriculum.

This qualification also provides vertical and horizontal articulation into higher education diplomas, and degrees offered at the University of Technology or traditional universities (Zinn, Raisch & Reimann, 2019). Buthelezi (2018) asserts that part of the government's plan establishing TVET colleges was to reduce the burden on high education institutions. For this reason, the NCV programme is designed to enrol the small number of students who see a need and who can afford it (Buthelezi, 2018). This plan was unsuccessful as the NCV course composition did not meet university admission requirements. The NCV programme has one language compared to high school academic Grade 12, which includes two languages. Universities find this unacceptable.

The official curriculum documents for NCV Mathematics are a subject guideline and assessment guideline (SAG). According to the DHET (2013), the formal curriculum document's content is the domain-specific declarative, procedural, tacit and situational knowledge targeted by the official curriculum document (DHET, 2013). The SAGs documents specify the learning outcomes. The curriculum also includes students with special needs.

Legislation on TVET colleges, as advocated for by the DoE (1998a), indicates that the NCV Level 2 to Level 4 qualifications were introduced to address programmes that are inadequate and economically irrelevant, as well as low technical and cognitive abilities of TVET graduate. Unfortunately, such laws have not been consistent with all the vocational training programmes, and have not received universal industry support. In particular, to support the training of artisans (Terblanche & Britzer, 2018). Challenges facing the curriculum were never anticipated, such as a failure to achieve artisan development at an expected rate (Buthelezi, 2018). TVET college graduates ate unemployed, and very few

of these are entrepreneurs. The lack of employment is due to rejection of the NCV curriculum in industries that are potential employers of the TVET products. A new curriculum was not accepted due to lack of communication with the employment sector, ignorance of the new curriculum, and scepticism about the type of human capital it would bring, resulting in a loss of confidence in skills training (Buthelezi, 2018). The government's urgency to produce artisans is not compatible with the NCV programme, since it takes three years to complete, and there is a high failure rate.

According to the DoE (2006), currently the NCV qualifications offered do not meet the curriculum goals set out in the FET ACT of 16 Papier (2009) focuses on the disappointing consequences and disastrous performance of NCV. In 2007, about 10% of NCV certificate was recorded, and the success rate remained low, as evidenced by a 14% throughput rate obtained in 2009 (DHET, 2012). The 2012-2016 pass rates increased, hovering between 29% and 41% (Badenhorst & Radile, 2018).

The study conducted by Papier (2009) revealed that the NCV EIC Programme from six colleges registered 849 students for L2 in 2008, out of which, 640 took the final examination, but only 68 passed and were certified. Amoo and Swart (2018) argue that the throughputs rate for NCV Mathematics is highly concerning for all certificates, where it has never exceeded 11 percent. Available data from White Paper for Post School Education (2013) indicate that the average certification rate for NCV is between 30% and 50 percent. The more realistic approximation is that about 2% of students entering NCV at Level 2 graduate after three years, and only 10% graduate after six years. The low throughput rates are especially evident in engineering and IT-related programmes. The average throughput rate in NCV courses in 2013 range from a dismal 0,6% in Civil Engineering, to 5% and 9% in Tourism. The national certification rate was 28% (DHET, White Paper for Post School Education, 2013). The low throughput rates result in a high cost per graduate. The annual student expenditure for NCV is approximately R27 000, so the cost per graduate is estimated at over R450 0000 (White paper, 2013).

The poor performance of students in Mathematics leads to poor performance in other subjects that involve calculations. If a student failed Mathematics in Level 2, they could not register for Mathematics L3. It can cost a student a full three more years to complete. This highlights the need for more research in the NCV Mathematics curriculum.

2.1.4 Mathematics curriculum interpretation and implementation

According to Bosman and Schulze (2018), Mathematics is the crucial subject necessary for economic development, particularly in developing countries. It is a subject that has become an important element in the development of science and technology (Noto, Pramuditya & Handayani, 2020). It is important to learn Mathematics, because it constitutes the foundation of all science fields. The importance of understanding Mathematics is to achieve meaningful learning. However, in South Africa, learners perform poorly in Mathematics, when benchmarked against their counterparts in other countries (Bosman & Schulze, 2018). South Africa's low Mathematics performance is endemic, and can be considered a national disaster (Amoo & Swart, 2018). This perpetual predicament can emanate from the fact that misinterpreting the curriculum is possible since the curriculum is implemented using second language, where the intention of designers may not carry over. Curriculum documents come in English, which is the second language of most TVET lecturers. Makonye and Fakude (2016) have discovered that it is the use of English as a medium of instruction and assessment that makes it difficult for learners to understand the addition and subtraction of integers.

The degree of correspondence between the actual curriculum and what happens during implementation will ultimately affect the curriculum received (Umigiraneza, Bansilal & North, 2018). According to Anderson and Elloumi (2008), there are three teaching approaches: a teacher-centred approach, which is suitable for presentation; a content approach, which is suitable for grading the content; and lastly, the learner-centred approach, which is suitable for contextualising learning. Certain studies (Kimani, Kara & Njagi, 2013; Tshabalala & Ncube, 2016) reveal that teachers use teaching methods that

are comfortable to them, like employing teacher-centred methods instead of a learner-centred method. A learner-centred approach incorporates the three important components of learning outcomes, namely: intended, implemented, and attained outcomes (Khoza, 2015b). The intended outcome is what is planned before learning begins, the implemented outcome refers to what occurs during learning, while the attained outcome entails what is observed from students and assessed after teaching (Paul, 2019).

Fullan (2001) identifies three sequential phases for active curriculum development, namely: initiation; implementation; and adoption. After the new curriculum was introduced, politicians rushed to adopt it (Fullan, 2001). This naivety in implementation widen the gap between curriculum and implementation (Molapo & Pillay, 2018). A difference between policy formulation and policy implementation is caused by: firstly, government policymakers consulting with teachers' union representatives and not the teacher political leadership; and secondly, the involvement of general members within the union (Molapo & Pillay, 2018).

Teachers alone are responsible for translating curriculum developers into practice, which means they have contacts with the classroom reality. Although teachers are the agents of change, the South African education system is highly bureaucratised. Bureaucracy acts as a means to organise and standardise the mission of teachers, thus, school bureaucracy is an effective control mechanism that guides the performance of teachers in ensuring order, rationality, accountability and stability in schools (Kean, Kannan & Piaw, 2018). The curriculum expert's committee designs the curriculum ideas at a national level. These ideas are implemented across the nation by the teachers who are neither involved in, nor consulted during the design phase.

Maphalala and Mpofu (2018) point to teachers as the curriculum drivers, who interact with the curriculum daily. Teachers can see what works and what does not work in a classroom situation when it comes to the outcomes. For this reason, they should be placed at the forefront of the curriculum transformation. Phaeton and Stears (2016) assert that teachers must know the curriculum requirements so as to implement the curriculum correctly, as

intended. In some instances, it has come to my attention that lecturers interpret curriculum through examination papers and textbooks and are reluctant to engage with curriculum documents. The disconnection between the intended and the attained curriculum may occur at the teacher's level, where the teachers' knowledge and pedagogy may result in an implemented curriculum that is vastly different from the planned curriculum (Molapo, Stearsand Dempster, 2012).

Teaching and learning Mathematics should always be based on conceptual understanding above all else. (Mahlabela, Mahlobo, and Ndaba, 2018). Van de Walle, Karp and Bay-Williams (2016) refer to understanding as the ability to think and act flexibly on a topic or concept. They refer to one of the hallmarks of mathematical knowledge as the ability of a student to justify why a given mathematical statement or answer is correct, or why a mathematical rule makes sense. Therefore, not only is language central to mathematical learning, but, he argues that understanding should be the main goal of all the mathematics we teach. Molapo et al. (2012) alludes to the fact that there is an abundance of research that demonstrates that learners may not be attaining the intended curriculum outcomes.

The ratio of South African vocational college lectures who are not academically or professionally qualified to teach is one in five (i.e., at least three years' full-time university tuition with an NQF grade of at least six or higher) (Zinn, Raisch & Reimann, 2019). The lecturers' interpretation of NCV Mathematics is under-researched at present. Statements about the underperformance of students in Mathematics raises questions, whether lecturers interpret the curriculum as planned.

According to Ndlovu (2018), 4.8% of lecturers in the TVET sector are academically and vocationally qualified as schoolteachers, 33.1% are academically qualified college lecturers, 36.3% possess only an academic qualification, 20.6% possess no skills, and the remaining 5.2% are not considered statistically. A large number of teachers with various qualifications offer a wide range of content and pedagogical, psychological and pedagogical competencies that can be used in general, in relation to content, in addition to absent teachers (Zin et al., 2019)

The programmme attracts many students with different level of academic readiness that requires very different groups of students in the same class (DHET, 2012). The frustration of students and lecturers may be at a high level. For this reason, lecturers need to possess high standards of knowledge on content delivery methods. TVET classrooms often involve students at different educational levels, with mixed learning abilities (Buthelezi, 2018). For some students, the content is challenging to master. Grade Nine students are the most challenged due to a lack of foundational Mathematics.

2.1.5 Implementing Mathematics curriculum during COVID 19 lockdown

In South Africa, the first confirmed case of COVID 19 was recorded on 5 March 2020 and lockdown began on the 27th of March to mitigate the spread of the virus (Mhlanga and Moloi, 2020). The fear of the predicted rate at which the pandemic was to infect people motivated the South African Government to declare this pandemic a national state of disaster in terms of Disaster Management Act (South African Government, 2020). The lockdown interrupted teaching and learning with nationwide school closure, the majority lasting at least 10 weeks (Mhlanga & Moloi 2020).

In response to the pandemic, governments around the world began to experiment with emergency remote teaching (ERT) (Chirinda, Ndlovu and Spangenberg, 2021). ERT is defined as a temporary shift of instructional delivery to an alternative delivery mode due to crisis conditions (Hodges, Moore, Lockee, Trust & Bond, 2020). It is different from ordinary online teaching and learning, in which virtual experiences and online instruction have been planned from the beginning (Hodges at al.,2020). ERT was also adopted to teach Mathematics at several countries including South Africa (Chirind, Ndlovu and Spangenberg, 2012). A study conducted by Aldon, Cusi, Schacht and Swidan (2020) reveals that demanding situations lead teachers to adapt teaching and to change their pedagogies. Teachers' engagement in distance teaching may have cause them to forget mathematics tools and mathematics didactic approaches.

TVET colleges subsequently announced that the academic calendar would resume online. Online learning was introduced as a means of ensuring that education continues. This can be defined as instruction delivered on a digital device that is intended to support learning (Gumede and Badriparsad, 2020). Online teaching and learning platforms were anticipated to facilitate access to learning and expand access to knowledge. According to Mpungose (2020), only a few students had access to online learning platforms. This hindered their transition from contact learning to remote learning (Mpungose, 2020).

The current pandemic has added a new layer of complexity and uncertainty to an already volatile and contested higher education sector, evidenced by protests on fees must fall (Motala & Menon, 2020). The situation has made an extraordinary demand on both lectures and students alike. Lecturers were required to adopt to new pedagogical concepts and modes of lecture delivery in which many have not been trained. Most of TVET lecturers and students did not have access to digital learning resources some lack the resilience and engagement to learn on their own. Lecturers had to try and supplement online learning by sending worksheets to students who do not have access to internet.

Gumede and Badriparsad (2020) asserted that the pandemic has highlighted the devastating digital literacy divide in South Africa within higher education. Digital literacy is an essential skill that students and lecturers are required to both display, and utilise in order to view digital information across various digital technologies (Gumede and Badriparsad, 2020).

The learning environment has had to change drastically in order to maintain the momentum of learning. Learning environment is learning programme that can be facilitated through contact lectures as well as online and blended learning (Khoza and Biyela; 2019). However, the need for social distancing has resulted in the elimination of contact activities that comprise the curriculum in the majority of South African TVET Colleges.

Most lecturers experienced difficulties in providing equal instructions to students, lacking adequate time to do their job well. In some cases, some did not have access to their

teaching and learning materials that were still at campuses. COVID 19 has caused significant negative impact on higher education institutions, because the closure of colleges not only interrupts the teaching for students, but also coincides with many exams being postponed.

Personally, it was an overwhelming experience creating new lessons in a way that I have never done before, trying to teach myself new ways to interact with my students and trying to make sure my own children are taken care of and completing their work with limited electronic devices, and unreliable network at home. I had family responsibilities that contributed to an imbalance in teaching and learning. Sometimes I had no electricity due to cable theft. A lack of real-time communication made it difficult to keep students motivated. So as to ensure teaching and learning take place in the midst of challenges I resorted to the use of WhatsApp as one of the platforms for teaching and learning.

According to Maphalala, Khumalo, and Khumalo (2021) WhatsApp is a smartphone app initially developed for instant communication through message exchange. Statistics show that by mid-2018, WhatsApp users sent over 65 billion messages per day, with an average of 29 million messages per minutes (Maphalala, Khumalo & Khumalo 2021). One feature that has made WhatsApp useful among TVET lecturers and students it is the ability to create groups within the application, which allows for collaboration on tasks and communication. Members of the group can participate and engage in a discussion, teaching and learning occur in a relaxed environment and conveniently sharing and accessing information (Maphalala, Khumalo & Khumalo, 2021). However, Motaung and Dube (2020) in their study revealed that 70% of students reported that WhatsApp negatively affected them in their studies, the study indicated students committed grammatical errors when submitting their work. Another challenge was the need for smartphones and data, but most students preferred WhatsApp because they were familiar with it. Interacting with fellow lecturers I discovered that using WhatsApp was challenging, as most learners could not understand course expectations and struggled to stay motivated due to the lack of in-person interaction.

Tamrat and Teferra (2020) found that in Africa, only 24% of population have access to the internet, however, they note that the frequent electricity power cuts, high cost of data, and poor connectivity continues to define circumstance. Annamalai (2019) in the study conducted in Malaysia suggest that WhatApp may have pedagogical implications, where it could not be used to discuss intensive reading materials, but instead, can be used to convey the information concerning assignments and examination only.

In the next section I discuss the framework of this study.

2.2 Part B: Framework

2.2.1 Introduction

This section presents the theoretical framework supporting this study and the analytical tools used. The aim is to explore how lecturers interpret and implement the NCV Mathematics curriculum at a TVET college. The research utilised Bernstein's theory of knowledge as a theoretical framework, and Graven's (2002b) analysis of original C2005 GET curriculum for Mathematics as an analytical tool. I will discuss the rationale behind the chosen frameworks, and their relevance to the study.

The theoretical framework is perceived as the most important part of research. It is like a microscope that a researcher uses to analyse the study at hand. Framework and theories assist in understanding the world, providing theories with which to understand research phenomena under close scrutiny (Paul, 2019). According to Grant & Osanloo (2016), and the DoE (2018), the theoretical framework refers to the structure that serves as the basis upon all knowledge is built (metaphorically and literally) for research studies, and serves as a structure and support for the rationale of research, the problem statement, the purpose, the significance, and the research questions.

A researcher's choice of framework is not random, but shows important personal beliefs and understanding about the type of knowledge, how knowledge exists (in the metaphysical sense) with respect to the observer, and the possible roles and tools that should be used to gather insight (Grant & Osanloo, 2016).

2.2.2 Bernstein's theoretical framework

Bernstein's theory has been used by different researchers in interpreting a variety of curricula. Several studies (see Singh, 2002; Mthethwa, 2013; Tapp, 2015; Machaba, 2017; Feje,Hylund & Wallin, 2019; Pirtheepal, 2019) have noted Bernstein's framework as a useful tool in curriculum interpretation. Its relevance likewise comes to bear in this study.

Bernstein (1977) asserts that there is a three-messaging system that can recognise knowledge of formal education, namely: curriculum (defining what is considered valid knowledge), pedagogy (defining what is considered the actual transfer of knowledge), and assessment (defining what considered the actual realisation of knowledge). The focus of this study includes curriculum and pedagogy. The official NCV Mathematics curriculum documents uses the Bernstein's three message system. Bernstein (1972, 1977, 1999, and 1996) provides useful models for this study. The following concepts by Bernstein are used as tools for analysis: Curriculum types (Collection type and Integrated type), Classification and framing; Realisation and Recognition rules; Pedagogy models (Performance and Competence).

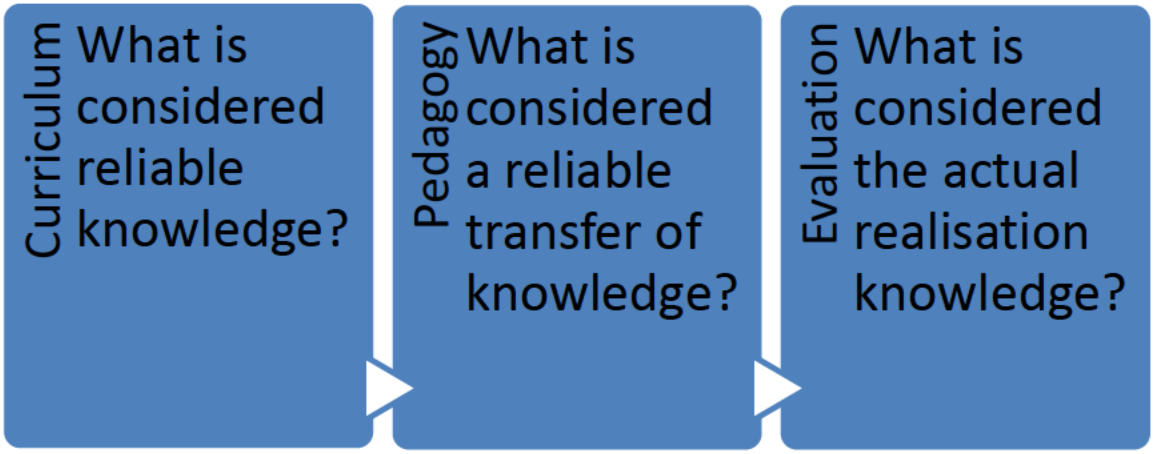

Figure 2.1 Bernstein's message system

Source: Pillars of education: Curriculum, pedagogy and evaluation (Bernstein, 1977).

2.2.3 Curriculum type

The curriculum highlights what is considered to be reliable knowledge. These choices focus on selection (the curriculum content), sequencing, (what order), pacing (how much time), and evaluation (what is important for assessment) (Bernstein, 1972; 2000). He describes the curriculum in two different ways, namely: the collection type, and the integrated type. The former exists if the content is connected and isolated from one another, characterised by strong classification and strong framing. In this type, students must organise their preferred content groups to meet some assessment criteria. The latter exists if the content stands in precise relation to each other, and it has weak classification and weak framing. Bernstein's theory reveals the subject areas, as well as school of knowledge, and everyday knowledge (Hoadley, 2006).

2.2.4 Classification and framing

Bernstein (2003) refers to classification according to the nature of the classification of content. For strict classification, the contents are well isolated from each other by strong boundaries. Weak classification reduces the isolation between content, because the boundaries between them are weak and blurry. Tapp (2015) asserts that Bernstein uses the concepts of classification and framing to analyse how decisions are made about what is considered reliable knowledge, how knowledge should be transferred, and how learners demonstrate knowledge acquisition.

According to Bernstein (1971, 2003), classification is concerned with how boundaries drawn concerning the curriculum's content, between what was learned, and what was not. Framing concerns how you choose, teach, and evaluate what needs to be learned (Bernstein, 2003). Another description of framing and classification by Fejes, Nylund and Wallin (2019) states that framing refers to the method of education, that is, how relationships are established with a given classification. Framing meanwhile concerns control, the governing principles of communication, and broader learning. Strong

structures are expressed through clear and explicit rules and principles for teaching and practice in the classroom, whereas weak structures are expressed through implicit rules and principles of teaching, which reduce clarity about how teaching should be undertaken (Fejes, Nylund & Wallin, 2019).

2.2.5 Realisation and recognition rules

According to Bernstein, the concept of classification and framing yield to the concept of recognition and realisation rules. Recognition rules at the level of the teacher are how individuals recognise the specialty of their context. The recognition rule essentially enables the appropriate realisation of putting things together (Machaba, 2017). The realisation rule determines how we put things together and make them public (Bernstein, 1996), and means that the teacher can produce a legitimate text in the required discourse (Machaba, 2017).

The aim here is to explore the recognition and realisation rules acquired and reflected in the teaching and learning of NCV Mathematics by TVET lecturers study explores the kinds of Mathematics lecturers' recognition and realisation rules acquired and reflected in the teaching and learning of NCV Mathematics, drawing from the official curriculum document. This curriculum document projects what the State considers to be valuable knowledge and pedagogic practice, that is, what counts as valid mathematical knowledge and teaching approaches that will enhance this curriculum's principles.

2.2.6 Pedagogy Model

Lecturers are agents of change. To bring change in education requires knowledge, skills, and strategies. Lecturers have a significant impact on student learning. For this reason, it is imperative to have an understanding of how they use their knowledge. Bernstein (2000) defines pedagogical practices as those forms of communication (interactions) undertaken in acquiring pedagogical knowledge. Furthermore, he argues that forms of communication

entail a forms of control, which dictate the nature of the talk and kinds of space constructed for the pedagogical practice's viability.

Bernstein makes a distinction between weak classification and invisible pedagogy as a result of framing. What to learn is an implicit and visible methods of teaching – the result of a strong classification and framing makes expectations for learning explicit. Singh (2002) suggests that framing a curriculum must take into account both recognition and realisation rules. Recognition rules have to do with determining what is appropriate in a given context, while realisation rules have to do with acting appropriately on that knowledge. The formation of any practice sets specific 'realisation rules', that is, rules for how to create legitimate communication in a given context (Fejes, Nylund & Wllin, 2019). Realisation and recognition rules are important for lecturers when transforming the curriculum. Tapp (2015) notes that strong framing can help students to learn recognition rules. However, it does not necessarily help them learn realisation rules that will enable them to act appropriately.

Pedagogic approaches need to help students acquire recognition and realisation rules by means of which to understand what they have to do, and how to approach doing it. This study explores the kinds of NCV Mathematics lecturers' recognition and realisation rules acquired in the teaching and learning of Mathematics. Drawing from the official curriculum documents, this document projects what the designers consider valuable knowledge and pedagogic practices that will enhance this curricula's principles.

2.2.7 Analytical tool

To analyse NCV Mathematics curriculum documents and the lecturer's responses on how the curriculum is designed, I drew from Graven's (2002) orientation to Mathematics knowledge evident within the curriculum. The orientations are as follows:

Orientation 1: Mathematics for critical democratic citizenship, allowing learners to critique mathematical applications in various social, political, and economic contexts.

Orientation 2: Mathematics as relevant and applicable to the aspect of everyday life and local context.

Orientation 3: Mathematics for inducting learners into what it means to be a mathematician, to think mathematically, and to view the world through a mathematical lens.

Orientation 4: Mathematics involves conventions, skills, and algorithms to master to gain access to further studies.

These orientations have been used by different researchers (Graven 2002; Parker 2006, 2006b, Venkatakrishan & Graven, 2006; & Mthethwa 2013) to analyse the assessment standards of Mathematics and Mathematics Literacy FET curriculum. Mthethwa (2013) used them to analyse lecturers' interpretations and implementations of the intended Mathematics Literacy. Hence, I find these a useful tool in analysing NCV Mathematics curriculum.

2.2.8 Link between Bernstein's theoretical framework and analytical tool

Bernstein's message system (curriculum, pedagogy and evaluation) provide a lens in interpreting lecturers' pedagogy practice in a classroom setting. This lens pays attention to how lecturers unpack and present the Mathematics curriculum. Do they do this as "Mathematics for critical democratic citizenship, allowing learners to critique mathematical applications in various social, political and economic contexts" (Orientation 1), or as Orientation 2? If they unpack it according to these orientations, then how is the curriculum designed? Which orientation does it follow? Do lecturers adhere to the designer's idea? Therefore, Bernstein's framework and Graven's (2002) orientation to Mathematics will answer the research questions, which are: (a) How is the design and structure of NCV Mathematics curriculum? And how do lecturers interpret and implement the NCV Mathematics curriculum?

2.3 Chapter summary

The literature discussed in Part A identified the challenges faced by the TVET sector within the NCV Mathematics curriculum. It is evident that there is a vast body of research that needs to be done in the TVET sector. This will help the TVET community to make informed decisions in improving the state of the TVET sector, and enhance the production of good results in the NCV Mathematics. The vocational training system suffered from insufficient partnerships with businesses and industry, as a result of which, vocational schools lacked the facilities to meets employers' skills requirements, and move young people to appropriate jobs (Powell & McGrath, 2013).

The discussion in Part B concerned unfolding the theoretical framework and analytical tool in viewing of the NCV Mathematics curriculum document and the lecturers' interpretation of the curriculum. The characteristics of the NCV Mathematics curriculum will be revealed by a further analysis of the document, which will be carried out in Chapter 5.

CHAPTER THREE

3. RESEARCH DESIGN AND METHODOLOGY

3.1 Introduction

Every research method is designed to explore specific research questions and here, attempts to appeal to a post-positivist approach that challenges traditional belief about absolute truth (William, 2007). Research methodology explains the approach and paradigms employed, and it is through the methodology that readers can understand the study. According to McGregor (2002), the research methodology is collecting and processing data within the framework of the research process. This chapter presents and discusses the methodological approach used in this study, that is: the paradigm adopted, the research design, research strategy, data collection methods, procedures and processes followed during the study stages. The chapter also discusses the sample and sampling procedures, as well as aspects of trustworthiness, credibility, conformability, and triangulation.

3.2 Research design

Research design determines how research is conducted, how the data is collected from the participants, and analyse data to answer the research questions. Betram and Christiansen (2014) state that a research design exists as a schema of how I will collect and analyse the data described in order to answer the research questions. The plan for this study will be discussed under data collection.

3.2.1 Case study

The primary research function of the research is to discover lecturers' interpretation and implementation of the curriculum. For this reason, a case study constitutes the best research design. Cresswell (2003) defines case study as an in-depth exploration of a programme, event, activity, and process of one or more individuals. Cresswell (1998) is of the view that the structure of the case study ought to include issues, context, and the lessons learned. This study is a single case study of one college, and subcases of three campuses within the college. The case study was selected as the most appropriate strategy for answering the research question, while anticipating obtaining rich data on how lecturers interpret and implement the NCV Mathematics curriculum. Yazan (2015) suggests that the case study is a practical inquiry that research the how or why questions concerning the phenomenon of interest. Yazan also argues that a case study is best defined as an analysis of complex issues in its real-life context. It aims to analyse features of a larger and similar phenomenon. Thus, the case study method is correctly understood as a way of defining cases. The data collection for case studies is extensive, and is based on a variety of sources, such as direct observation or observation of participants, interviews, archival records or documents, articles, and audio-visual materials (Williams, 2007). Hence, this study adopted document analysis and semi-structured interviews.

3.3 Research approach

A qualitative research approach is relevant to this study, because I aim to understand, how and under what circumstances behaviour comes into being. Each act, word, and gesture is significant in the qualitative researcher (Bogdon & Biklen, 2007). Also, McGuirk and O'Neill (2016) assert that qualitative study also aims to understand how people perceive events, places, and processes in different ways as part of a changing reality.

3.4 Qualitative approach

This study employed an approach which is qualitative in nature, and which is scrutinised through qualitative methods. A qualitative approach is preferred in this study, because it provides an understanding of a situation as it takes place. A qualitative researcher is interested in naturally unfolding situations and unique personal perspectives, using an inductive approach to analysis and acknowledges the role of researcher subjectivity (Fraenkel & Wallen, 1993). Qualitative methodologies can be used as tools for improving our comprehension of teaching and learning, because they seek illumination, understanding of individual participants including their opinions, perspective, and attitudes, and extrapolation to similar situations (Zuga 1994; Hoepfl, 1997 and Hassaji, 2015).

3.5 Research paradigm

The proposed study uses a qualitative approach, where an interpretive process is appropriate. Interpretivist researchers believe that people strive to understand their world, and develop personal meaning for their experiences (Cohen, Manion & Morrison, 2011). This paradigm will serve the purpose of exploring the virtual platform for the participants' world and their involvement, interpretation and experiences. The interpretive paradigm allowed me to understand how TVET college lecturers interpret the curriculum. It is essential to understanding what interpretations they give the curriculum, or in turn add or subtract to/from the curriculum, and why. Cohen et al. (2009) state that an interpretive paradigm aims to understand different human experiences. Therefore, this study must gain knowledge on TVET college lecturers' interpretation of the intended NCV Mathematics curriculum so as to attach meanings to the world in which they live.

3.6 Sampling and sampling procedure

A research study requires a specific group of people to be participants. This study is conducted in KwaZulu-Natal, around Durban. The targeted college has eight campuses scattered across the eThekwini Municipality. For the purpose and convenience of this study, three campuses were selected. According to Nzimande (2019), for qualitative research, it is not easy to use the entire population as a research sample to obtain the necessary information, and the major cause of such difficulties may be the financial cost and the availability of the participants involved.

Maree (2007) describes the aim of sampling a small or manageable number of study participants. Since the study did not aim to generate results that will be used to create generalisation about the entire population, six NCV Mathematics lecturers were selected, and five of them participated. For this reason, convenience and purposive sampling were adopted. Convenience and purposive sampling are strategies used by a researcher to select a sample that will meet his or her criteria (Etikan, Musa & Alkassim, 2016). In a convenience sampling, members of a targeted population meet specific practical criteria. The criteria can include: accessibility; availability; and willingness to participate in the study.

3.7 Data collection methods

Data collection methods are an important part of any research project as they are the core of its success. In this study, the data collection methods include document analysis and semi-structured interviews.

3.7.1 Document analysis

Curriculum document analysis was carried out so as to determine what should be taught in NCV Mathematics classroom, and how it should be taught. I have looked at the curriculum document with a critical eye and cautioned forming the meaning of the documents, and their role in the study.

The documents analysed were subject's guidelines Level 2, Level 3 and Level 4, with eleven and fourteen pages, respectively. Assessment guidelines Level 2 have twenty pages; Level 3 twenty-four and Level 4 twenty-six pages. The aim was to closely scrutinise the hints in the curriculum regarding the implementation, and the way in which lecturers interpret those hints.

A number of researchers have embarked on document analysis (see for example Gagel, 1997; Merriam, 1988; Hansen, 1995 and Connell, Lynch & Wering, 2001). Document review is a procedure for verifying or evaluating documents whether are a soft or hard copy (Bowen, 2009). The systematic procedures include retrieval, selection, evaluation (understanding) and synthesis of data contained in documents (Bowen, 2009).

Document analysis is a methodological method of studying documents, in which data must be analysed and interpreted to gain understanding, and develop practical knowledge. The practice of scrutinising and analysing documents to provide direction, understanding and meaning for the development of empirical knowledge (Corbin & Strauss, 2008; Rapley, 2007).

3.7.2 Semi-structured interviews

In qualitative research, semi-structured interviews are important in a sense that they allow researchers to explore different viewpoints and to gather different people's experience (Flick, Von Kardoff & Steinke, 2004). They consider the meaning of experiences and the

reality and meaning of those experiences can be informed by discourses, assumptions, or ideas that exist in a wider range of society (Braun & Clarke, 2006).

A semi-structured interview schedule was used to bring up topics where participants could respond in their own way and discuss issues of concern regarding the curriculum. The interviews address questions about participants' understanding of the curriculum, their views about the purpose of the curriculum and the challenges they encounter implementing it.

Due to the pandemic, semi-structured interviews were held online via Zoom. The semi-structured interviews were treated as an enquiry; they were open and flexible, allowing lecturers the space to explore and deliberate on their own understanding of how the curriculum is and how they implement it.

Lecturers had an opportunity to reflect on their teaching when answering the semi-structured interviews. Ndlandla (2017) explains that I ask the participant a sequence of predetermined open-ended questions in a semi-structured interview. Open-ended questions keep the ball rolling, and they make interviewees answer questions freely. Consequently, semi-structured interviews provide rich information that helps understand the phenomenon as perceived by the participants (Ndlandla, 2017). All semi-structured interviews were recorded and transcribed verbatim. Document analysis and semi-structured interviews triangulated the data. Triangulation use two or more data collection methods in the research of human behaviour (Cohen & Manion, 1994).

The following table shows the alignment between the research questions and data collection.

Table 3.1 Alignment between the research questions and data collection

Research questions	Data collection methods
How is the design and structure of NCV Mathematics curriculum?	Document analysis
How do lecturers interpret and implement NCV Mathematics curriculum?	Semi-structured interviews

3.8 Data analysis process

Raw data cannot help the reader to understand the case in question and how the participants see it. Such data needs to be analysed to gather insight. Data analysis can reduce large and complex data to make it more understandable (Kawulich, 2004). LeCompte (2000) opines that analysis is the process a researcher uses to reduce and interpret data into history. The purpose of qualitative data analysis is to define categories, relationships, and assumptions that provide participants with a general worldview and, in particular, information about a topic (Basit, 2003).

The scholars (Spiggle, 1994; and Ngulube, 2015) agree that qualitative data analysis deals with transforming raw data so that it can be interpreted and presents an underlying meaning. Data was analysed using the following process adapted from Creswell and Creswell (2017):

- Generate data: Document analysis and semi-structured interviews generated data.
- Analyse and Transcribe data: I analyse curriculum documents and transcribe semi-structured interviews.
- Read data: Interviews were thoroughly read to obtain general sense of the received data.
- Coded data: I identified segments of the text and assign codes to them.

- Identify Themes: I identify themes that emerged from the data and used lecturers' responses quotes in the report and introduce the analytical tools for document analysis-orientations.

3.9 Ethical considerations

Ethics plays a vital role in research, since these involves humans. Ethical committees in the institutions make it obligatory that participant's right are protected from any abuse. According to Du Plooy et al. (2014), ethics refers to the degree of morality and honesty of research based on professional ethics. Researchers (Crewell, 2009; Allmark, 2002 & Du Plooy, 2014) have agreed that research ethics refers to the moral act guided by principles and acknowledgment of people's rights.

After receiving permission from the College Rector (gatekeeper) and before meeting the participants to conduct research, I applied for ethical clearance from the UKZN Human Social Science Research Committee (UHSSRC). When the ethical clearance letter was issued, I asked the identified participants to discuss ethical matters. Participants were sent emails and WhatsApp invitations to participate in the study. Participating lecturers were informed accordingly about what the study entailed. Participants were given assurance of their anonymity, the right to withdraw, and what kind of information is required. Participants were emailed consent letters, and they all append their initials since they did not have electronic signatures.

According to Walford (2005), anonymity refers specifically to not including the real names of participants or research site, and excluding information that can make the participants or research site identifiable. In this study, I used Walford's (2005) definition of anonymity, where the names of the participants and research site are not included, and no information about an individual or research identifies that person or research site (Walford, 2005). To protect the privacy of participants, I have used pseudonyms instead of real names.

3.10.1Trustworthiness

The value of a research study is enhanced by its trustworthiness. Amankwaa (2016) asserts that all research must be true, stable, and neutral, in order to be deliberated valuable. Furthermore, the result of establishing rigour or trustworthiness for each method of research requires a different approach. Strategies such as credibility, transferability, and confirmability can be followed, ensuring trustworthiness (Shenton, 2004). Trustworthiness of this study is confirmed by credibility. Statistics Solution (2019) view credibility as the most important aspect of trustworthiness, because it involves clearly linking the research findings to reality in order to prove them to be true.

3.10.2 Credibility

In terms of credibility, researchers want to show that they have provided an accurate picture of the phenomenon under investigation (Shenton, 2004). Techniques for establishing credibility are long-term interaction, continuous observation, triangulation, briefing with peers, analysis of negative cases, adequacy of references, and participant validation (Amankwaa, 2016). This study adopted triangulation by analysing the curriculum document and conducting semi-structured interviews. In the semi-structured interviews, lecturers had a chance to look back on their daily teaching as a whole. The detailed descriptive interpretation of the curriculum gave the researcher the true value of the information about their lived experience. The interviews took 30-45 minutes, as Du Plooy, Davis, and Bezuidenhout (2014) suggest that the more time you spend with potential participants, the greater your understanding of their situation and the greater your confidence in the information and results gathered.

3.10.3 Triangulation

Cohen, Manion and Morrison (2002) allude to the fact that when we study human behaviour and use more than one data collection method, we are triangulating the data. Triangulation refers to a process of qualitative cross-validation (Wiersma, 2002). Denzin (2017) understands triangulation as a strategy to confirm four different forms: triangulation of theories (approach data with different point of views); investigator triangulation (used to offset the subjective effect of an individual); methodological triangulation (using the same method on different occasions or different approaches on the same object of study); and triangulation of data (incorporating data from different places).

In accordance with Cohen et al. (2002), as well as Wiersman and Denzin (2017), the study employed data triangulation. Document analysis and semi-structured interviews were used to determine what lecturers should do (document analysis), say they do (semi-structured interviews), and thus support methodological triangulation. Fusch, Fusch and Ness (2018); Mohajana (2017) and Gunawan (2015) agree that triangulation promotes validity and reliability (hence trustworthiness) of data and results in qualitative research, thereby mitigating the participants' and my biases. By triangulation, I strive to present evidence that breeds credibility (Eirsner, 1991). Triangulation helps the researcher defend against accusations that research findings are mere artefacts of one method, one source, or one researcher bias.

3.10.4 Confirmability

In establishing confirmability, Lincoln & Guba (1985) have suggested confirmability audit, audit trial, triangulation, and reflexivity. Ensuring confirmability, the study adapted triangulation. Confirmability is concerned with the affirmation as to whether the findings

reflect the experiences and ideas of the participants, and furthermore, provides assurance that the position of the researcher has no undue influence to the findings (Shenton, 2004).

In supporting confirmability, I provided the participants the same set of interview questions. All recorded interviews were transcribed verbatim. Participants confirmed the transcripts as true reflection of their responses. I admit situations that are considered prejudicial, that can affect the data. I tried not to use my power as a researcher to manipulate data or affects results.

Bertram and Christiansen (2014), as well as Marshall and Rossman (2006) are of the view that it is normal for a research project to have limitations and challenges, regardless of the research methodology and approach adopted. At the time of data generation, the country faced a hard lock down. As noted, in South Africa, this meant that the government enforced a national quarantine, which meant the complete closure of all schools, including TVET colleges and universities (Mhlanga & Moloi, 2020).

The UHSSRC had advised that no field work be conducted due to COVID 19. Consequently, it was necessary to cancel class observations, which was limiting the data collection. Instead, data was collected using document analysis and semi-structured interviews, which were held online. The initial plan was to have six participants, but due to network instability, one participant could not be reached. Participants complained about not having data, since the semi-structure interviews were online. I was required to buy data for all the participants, where conducting semi-structure interviews online prolonged the time frame for the interviews and the study.

3. 12 Chapter summary

This chapter contemplated the research methodology, which explains the research paradigm, research design, research approach, research strategy, sample and sampling procedures, data collection methods, data analysis process, ethical consideration

trustworthiness, credibility, triangulation, confirmability, and lastly limitations and challenges. The methods mentioned indicated how the study intends to achieve research objective, which is to explorer lecturers' interpretation and implementation of the intended NCV Mathematics curriculum. The methods used also highlighted how the research question is going to be answered. The next chapter discusses and represents the findings obtained from data analysis.

CHAPTER FOUR

4. DATA PRESENTATION, ANALYSIS AND FINDINGS

4.1 Introduction

This chapter discusses data analysis and the themes emerging from the data. The data will be organised into two parts. Part A presents the findings the analysis of the document and Part B will present analysis of the data collected through the semi-structured interviews. To engage in the critical questions, the structure of the intended curriculum as stated in the curriculum document is analysed.

The importance of analysing the curriculum document is as follows: (i) the first research question explores the structure of the NCV Mathematics curriculum. For this reason, it is of utmost importance to analyse the planned curriculum; and it helps to understand the whole design of the curriculum; (ii) data collected through semi-structured interviews will answer the second research question. It relates to understanding how lecturers interpret the intended curriculum, in terms of whether they deviate from the curriculum or adhere to it.

The concepts of Bernstein's theory of classification and framing provide a useful explanation, analysis of the documentation of the curriculum, and teaching practices of teachers when describing key issues in the curriculum. Through the lecturers' interpretation, the Bernstein's theory of classification and framing allows I to comprehend how strong or weak the design and the implementation of the curriculum.

4.2. Part A: Analysis of the design and structure of the NCV Mathematics curriculum

The purpose of analysing the design and structure of the NCV Mathematics is to answer the first research question.

How is the design and structure of NCV Mathematics curriculum?

The curriculum document from Level 2 to Level 4 comprises six objectives. The objectives provide a broader description of what learners will be able to do. Implicit in the objectives are the aims with regards to teaching methods. Aims are not specified for each level. It is up to the lecturers to interpret and think of the best way to implement the curriculum. Teaching methods are not explicitly stated but are implicit in the curriculum, and lectures are expected to define them in the study of curriculum document.

Observations and concerns regarding the NCV Mathematics curriculum do not specify the particular focus, specifically on the vocational stream or academic stream. It is intended for students who wish to study mathematics, or enrol in courses that require mathematics. The table below presents an overview of the curriculum design from L2 to L4. It describes the document in relation to the theoretical framework. The description speaks to the first critical question: How is the NCV Mathematics curriculum designed?

Table 4.1: Overview of NCV Mathematics curriculum documents

1. Subject guidelines			
NCV Mathematics documents	Pages	Description	Comments concerning framework
NCV Mathematics L2 NCV Mathematics L3 NCV Mathematics L4	11 14 14	Subject guidelines document. The first page has the following headings: A. definition of Mathematics. B. Importance of Mathematics as a Fundamental subject? C. Learning Outcomes link with the Critical and Developmental Outcomes? D. Factors contribute to achieving the Learning Outcomes.	This document represents what is considered as valid knowledge in message system curriculum.

1. Assessment guideline			
NCV Mathematics documents	Pages	Description	Comments concerning framework

NCV Mathematics L2 NCV Mathematics L3 NCV Mathematics L4	20 24 26	Assessment guideline has three sections: Section A: "the purpose of the subject assessment guideline" Section B: Assessment in the NCV Section C: Assessment in Mathematics	This document deals with what the learner considers to be realisation of useful knowledge.

The above table shows the overview of the curriculum documents to paint a picture of what the document looks like. To continue with the analysis and the attempt to answer the first research question: How is the NCV Mathematics curriculum designed? I looked at the definition of the NCV Mathematics curriculum as stated in the curriculum document in terms of Bernstein's terms of classification.

NCV Mathematics subject guidelines NQF L2-L4 have extracted Mathematics definition from Reader's Digest Oxford Complete Word finder and defined it as follows: "Mathematics is the abstract science of number, quantity, and space studied in its own right" (DHET, 2013: 1).

This definition implies that Mathematics has a unique language and symbolism different from daily life. It enables lecturers to understand that the content of mathematics they are teaching, and prepares students to further mathematically orientated studies. It then suggests that lecturers "should use the correct mathematical language, symbols and notations when teaching mathematics, thereby enhancing the conceptual understanding of Mathematics. Using Bernstein's terms, that is to apply realisation and recognition rule.

The type of curriculum known as performance curriculum is the plan of teaching that is guided by professional reasoning, where the subject content is prescribed to drive the structured system of this curriculum (Makumane & Khoza, 2018). Another type of curriculum known as competence curriculum is driven by the achievement of learning

outcomes and those learning outcomes are driven by social reasoning, this type of curriculum aims to promote social skills (Khoza, 2018).

The definition in the curriculum document is stated as follows:

> NCV Mathematics enables creative and logical reasoning about problems in the physical and social worlds and Mathematics itself. Through mathematical problem-solving, students can understand the world and use that understanding in their daily lives. Knowledge in the mathematical sciences is constructed through the establishment of descriptive, numerical and symbolic relationships. The Subject Outcomes and Assessment Standards for Mathematics are designed to allow all students to become citizens who will be able to deal with Mathematics confidently and when it affects their daily lives, their community, and the world in general (DHET, 2013: 1).

The above description of NCV Mathematics includes competence curriculum characteristics, as it promotes social skills. The definition of NCV Mathematics is a combination of competence and performance curriculum. According to Makumane and Khoza (2020), a combination of competence and performance curriculum results in a pragmatic curriculum, which is driven by a teachers' personal reasoning.

According to Graven and Vankatakrishnan (2007), the definition of such nature explains three critical elements of Mathematics. The content (that is the Mathematics); the "context" (that has to do with solving everyday life problems) and the abilities and behaviours of a person with an aptitude for mathematics (analysing and problem solving skills). What is vague is that these three factors must evolve together. A weak classification is described by moving between content and context. An ambiguous indication is that permeate all content means a weak frame. So it follows the invisible training that comes from the weak classification.

4.2.1 Mixed classification and framing

The definition of NCV Mathematics involves two different concepts, based on different classifications, used specifically in reference to mathematical knowledge. On the other hand, it is defined as a subject that can develop weakly classified skills and competences. It enables students to be responsible people, who can solve problems in their social world and manage life in general. Here, the curriculum is given a weak classification and framing. This is an indication that there is a possibility of a range of different interpretations of the curriculum.

4.2.2 Aims of NCV Mathematics

Hyland, Kennedy and Ryan (2009) and Khoza (2015b) assert that aims, objectives, and outcomes are all perceived as teaching goals. Teacher's intentions can be both indicated by aims, which are long-term goals; and objectives, which refer to short-term goals (Khoza, 2016). The different level of complexity can be reflected by constructing outcomes with measurable keywords (Khoza, 2016). According to Carl (2009), aims are also used to convey a message from a macro-level to a micro-level to provide guidance for teachers and those who will implement the curriculum. Aims or goals provide guidance on approaches to curriculum delivery, which may be competence or performance-oriented, or mixture of both (Nzimande, 2019).

A competence curriculum, which is also known as an integrated/horizontal curriculum, is inclined to opinions, routines, or general knowledge and oral conversation. In this type of curriculum, knowledge is mainly generated horizontally, from simple sources or known regions (Khoza, 2016). In the competence curriculum, subjects are combined to form a learning area. For example, in South Africa, during the time of the competence curriculum from 1997-2012 (Curriculum 2005-C2005, Revised National Curriculum Statement-RNCS,

National Curriculum Statement-NCS) Mathematics, Physical Science and Technology were combined into a single learning area (Khoza, 2016).

erformance curriculum, also known as collection/vertical curriculum, is a professional (discipline/content) vision (rationale/reason) that puts a discipline or profession at the centre of teaching/learning environment (Khoza, 2016). Cognitive domains are more empowered than others in performance curriculum, and are used to assimilate specific content to determine whether students will success in specific domains (Bernstein, 1999). In a performance curriculum, each subject or discipline is independent, and has its set of expressions (concept, theories, language, culture and ideologies, and knowledge) (Khoza, 2016).

The NCV Mathematics (NQF Level 2-4) equips students with the following skills:

i. to be able to communicate properly, describe graphs, symbols, tables and diagrams;
ii. to apply mathematical processes to recognise, pose and solve problems in a creative way;
iii. to construct, interpret, and manage real-world behaviour and apply mathematical knowledge that shows accountability and compassion to social issues
iv. to collaborate as a team and group to improve mathematical understanding; and
v. to take a responsible approach to quantitative argumentation on local, national, and global issues.

According to Bernstein (1999), Hoadley and Jansen (2013), the outcome approach used to deliver content focuses more on what the student needs to know, understand, achieve and become then what the teachers expect. In the South African context, outcomes are classified into subject outcomes (SO), and learning outcomes (LO), both of which are product goal-oriented (Nzimande, 2019). In addition, the critical cross-field outcomes (CCFO) and the critical development outcomes (CDO) are process goal oriented (Nzimande, 2019). According to Khoza (2016), in South Africa, competence curriculum was driven by specified outcomes that were divided into critical outcomes and

developmental and learning outcomes. The achievement of observable/measurable outcomes is a major practice in competence curriculum (Khoza, 2016).

4.2.3 Critical Cross-field Outcomes and Developmental outcomes of NCV Mathematics

1. Use critical and creative thinking to identify, solve, and make decisions.
2. Think critically and be able to evaluate information.
3. Effective communication using mathematical symbols, visuals, and verbal skills in a variety of modes.
4. Understand that problem-solving context do not exist in isolation and show and understanding of the world as a set of interconnected systems.
5. Look back and understand different strategies to learn more effectively.

Below, the NCV Mathematics DHET's definition is analysed using Graven's (2002b) analysis of the original C2005 GET curriculum for Mathematics, in which she identified four different orientations to Mathematics:

Orientation 1: Mathematics for critical democratic citizenship, allowing learners to critique mathematical applications in various social, political, and economic contexts.

Orientation 2: Mathematics as relevant and applicable to the aspect of everyday life and local context.

Orientation 3: Mathematics for inducting learners into what it means to be a mathematician, to think mathematically and view the world through a mathematical lens.

Orientation 4: Mathematics involves conventions, skills, and algorithms to master to gain access to further studies.

Table 4.2: NCV Mathematics orientation

NCV Mathematics Aspect	Orientation Emphasized

Be able to communicate properly using description in words, graphs, symbols, tables and diagrams.	First orientation with some relations to second orientation.
Use mathematical procedures to recognise, pose and solve problems in a creative way.	First orientation with some relations to third orientation.
Construct, interpret, and manage real-world behaviour in significant mathematical ways that shows responsibility and compassion to personal and broader social issues.	Third orientation with some relations to firs orientation.
Collaborate as a team and group to improve mathematical understanding.	First orientation with some relations to third orientation.
Collect, analyse and organise quantitative data to evaluate and comment on conclusions.	First orientation with some relations to third orientation.
Responsible approach to quantitative argumentation on local, national and global issues.	Second orientation with some relations first orientation.

The above table shows the analysis of NCV Mathematics definition presented in the curriculum document. The analysis is done using Graven's (2002b) analysis of the original C2005 GET curriculum for Mathematics. The aim is to answer the first research question: How is the NCV Mathematics curriculum designed?

The definition corresponds with Orientation 1 and Orientation 3, Orientation 2 is less covered, and Orientation 4 is not covered. Therefore, NCV Mathematics is a structure of applied mathematics, including problem-solving and mathematical modelling within various contexts, including real life. It is also describing NCV Mathematics as a practice and systematic way of thinking about viewing and structuring the world and communicating in the world.

Table 4.3 below provides further analysis of the NCV Mathematics in terms of Basil Bernstein's (1982, 1996) Models.

Table 4.3: NCV Mathematics in Bernstein's terms

Basil Bernstein's notion	**NCV Mathematics**
Type of Curriculum Combination of collection and integration curriculum type *collection type* (exists when the contents are restricted and separated from each other) and the *integrated curriculum type*, exists where the contents are open to each other (Bernstein,1972)	Since NCV Mathematics is orientated around Orientation 1, 3, and some relationship with Orientation 2, it follows an integrated curriculum type.
Pedagogy model Bernstein (1996) describes two models: the competence model and the performance model. Competence models are linked in a learner-centric way, focusing on what the learner knows and can do at the end of the course (Taylor, 1999). Performance model concentrate on the content and texts.	NCV Mathematics determined learning outcomes that the learner would achieve at the end of the learning process. Therefore, if facilitates a learner-centred approach that follows OBE. According to the DoE (2003:3), OBE forms the foundation of the curriculum in South Africa. It strives to ensure that all students achieve their maximum learning

	abilities. NCV Mathematics curriculum thus follows a competence model.
Classification Classification is *strong* (where boundaries are explicit, and categories are insulated from one another), or *weak* (where there is integration or where the boundary is weak or blurred).	Integrated-type of the curriculum is weakly classified.
Framing Framing is about who has a control (Bernstein, 1996). Bernstein (1971) defines framing as the level at which teachers and students control selection, ordering, and pacing.	Characteristics of an integrated type of the curriculum are weak classification and weak framing.

4.3 Curriculum document review

In the review of the curriculum document, below is the further analysis of three aspects of NCV Mathematics, which forms the basis for analysing whether lecturers are in par with the curriculum or they deviate. These aspects are the design, content, and context of the curriculum. The aspects are discussed in the sections that follow.

4.3.1 Curriculum design

The definition and aims of the NCV Mathematics shows that the curriculum is poorly classified. However, this is not exactly in line with other parts of the curriculum, such as Subject Outcome (SO) and Learning Outcomes (LO). NCV Mathematics curriculum for levels 2-4 is structured into five topics. The SAGS documents (Subject and Assessment

Guidelines), which are the curriculum documents, provided an overview of topics to make the vertical curriculum more understandable. Vertical curriculum refers to the combination of topics and issues that will be taught in the same subject area during the current and later years in schools. (Shulman, 1986, p.10). Umigiraneza, Bansilal and North (2018) opine that “in Mathematics, teachers who pay attention to the arrangement and order of concepts in a vertical curriculum will gain a deeper understanding of several important concepts underlying the concepts Mathematics. A significant idea in mathematics can refer to a comprehensive concept that brings together many small ideas that can be explored in early grades (Umigiraneza, Bansilal & North, 2018).

However, a horizontal curriculum links the subjects in the school curriculum. It includes knowledge of the teachers regarding how they associate the content of a lesson to a topic or problem discussed concurrently in another lesson (Shulman, 1986, p.10). Therefore, the horizontal alignment of curriculum is a way of exchanging ideas in Mathematics. Using horizontal curriculum helps students clarify how skills acquired in one area of mathematics are structured in different ways, or at least can be shared information (Umigiraneza, Bansilal & North, 2018).

Table 4.4: NCV Mathematics Topics

Level	Topics
NCV Level 2	1: Numbers 2: Functions and Algebra 1.1 Functions 1.2 Algebra 3: Space, Shape, and Measurements 3.1 Geometry 3.2 Trigonometry 4: Data Handling 5: Financial Mathematics
NCV Level 3	1: Complex Numbers

	2: Functions and Algebra 2.1 Functions 2.2 Algebra 2.2.1 manipulate and simplify algebraic expressions, solve algebraic equations and inequalities 2.2.2 Linear Programming 2.2.3 Differential Calculus 3: Space, Shape, and Measurements 3.1 Geometry 3.2 Trigonometry 4: Data Handling 5: Financial Mathematics
NCV Level 4	1: Complex Numbers 2: Functions and Algebra 1.1 Functions and algebra 1.2 Linear programming 1.3 Differentiation 1.4 integration 3: Space, Shape, and Measurements 3.1 Geometry 3.2 Trigonometry 4: Data Handling and Probability Models 4.1 Statistics 4.2 Probability 5: Financial Mathematics

The above table shows the topics in each level to see how are the topics structured. Below it a further analysis of the content in attempt to answer the first research question: How is the NCV Mathematics curriculum designed?

4.3.2 Content of NCV Mathematics

The content analysis will help in the understanding of the curriculum developers envisioned. These documents serve as a basis for measuring the instructor's interpretation, and provide insight into the content.

Table 4.5 NCV Mathematics subject outcomes Level 2, 3 and 4

	Subject outcome		
Topics	Level 2	Level 3	Level 4
1	1.1 Use computational tools and strategies and make estimates and approximation.	1.1 Represent complex numbers in a form appropriate to the context.	1.1 Work with complex numbers.
1	1.2 Demonstrate an understanding of numbers and relationships among numbers and number systems and present numbers differently.	1.2 Perform operations on complex numbers.	1.2 Solve problems using complex numbers.
2	2.1 Use a variety of techniques to sketch and interpret information from graphs of algebraic and transcendental functions.	2.1 Use a variety of techniques to sketch and interpret information from graphs of functions.	2.1 Work with algebraic expressions, use the remainder and the factor theorem.

2	2.2 Manipulate and simplify algebraic expression.	2.2 Manipulate and simplify algebraic expressions.	2.2 Use a variety of techniques to sketch and interpret information for graphs of the inverse of a function.
2	2.3 Solve algebraic equations and inequalities.	2.3 Solve algebraic equations and inequalities. 2.4 Use mathematical models to investigate linear programming problems. 2.5 Investigate and use the instantaneous rate of change.	2.3 Use mathematical models to investigate linear programming problems. 2.4 Investigate and use the instantaneous rate of change of a variable when interpreting models both in mathematical and real-life situations. 2.5 Analyse and represent mathematical and contextual situations using integration rules.
3	3.1 Measure and calculate physical quantities.	3.1 Calculate the surface area and volume of two and three-dimensional shapes.	3.1 use the Cartesian co-ordinate system to derive and apply equations.

3	3.2 Calculate perimeter, surface area and volume in two and three-dimensional geometrical shapes.	3.2 Use the Cartesian co-ordinate system to derive and apply equations.	3.2 Explore, interpret and justify a geometric relationship.
3	3.3 Use the Cartesian co-ordinate system to derive and apply equations.		3.3 Solve problems by constructing and interpreting trigonometric models.
3	3.4 Use and apply a transformation to plot co-ordinates.		
3	3.5 Solve problems by constructing and interpreting geometrical models.		
3	3.6 Solve problems by constructing and interpreting trigonometric models.		
4	4.1 Central tendency of ungrouped data, namely the mean, median, and mode are calculated.	4.1 Calculate, represent, and interpret measures of central tendency and dispersion in univariate numerical ungrouped data.	4.1 Represent, analyse, interpret data using various techniques.

4	4.2 Represent data effectively.	4.2 Calculate, represent and interpret measures of central tendency and dispersion in univariate numerical.	4.2 Use variance and regression analysis to interpolate and extrapolate bivariate data. 4.3 Use experiments, simulation, and probability distribution to set and explore probability models.
5	5.1 Plan and personal and household finances.	5.1 Plan and describe how to manage the finances of social clubs.	5.1 Use mathematics to plan and control financial instruments.
5	5.2 Use simple and compound interest to explain and define a variety of situations.	5.2 Use simple and compound interest to explain and define a variety of situations.	

Examining the above table, the content of the subject outcomes of NCV Mathematics, one can observe that transferring everyday knowledge to mathematics is less obvious. The focus is on correct mathematics as a discipline. All learning outcomes and assessment standards are written in a language that can be delivered competently on the student's requirements to demonstrate outcomes.

Parker (2006), using Bernstein (1996) terms of strong and weak classification, argues that when the boundary is strong, the contents are well insulated from one another, where the 'voice' of the subject/discipline dominate, and thus, classification is strong. When the boundary is relatively weak, other 'voices' enter into subject/discipline and therefore, classification is weakened, and the curriculum becomes more integrated

According to Parker (2006), there are different types of integration: between subject disciplines and local/everyday knowledge, referred to as inter-discursive integration; between other subjects/ disciplines (e.g., between Mathematics and physics), referred to as interdisciplinary integration; and within a particular subject/discipline (e.g., algebra and geometry as two branches of Mathematics), referred to as intra-disciplinary integration.

When considering the actual focus of NCV Mathematics, the focus of integration becomes more visible. NCV Mathematics seems to have broadened school Mathematics' focus by encompassing Mathematics, applied Mathematics, and statistical Mathematics. I viewed as knowledge field of Mathematics, rather than a single discipline.

I extracted the headings from Parker (2006), Table 2: The focus of integration in the NCMS.

Table 4.6 Focus of NCV Mathematics

NQF Level 2

		Discipline in Mathematics			Focus of integration		
Topics	Subject outcomes	Maths	Applied Maths	Statistics	Within Maths	Between Maths and other subjects	Between Maths and everyday life
Numbers	2	2	2	0	2	2	1
Functions and algebra	3	3	0	0	3	3	2
Space, Shape, and measure-ments	6	6	3	0	6	3	3

Data Handling	2	0	0	2	2	2	2
Financial mathematics	2	1	1	0	1	2	2
Total	15	11	6	2	14	12	10
%	100	73	40	13	93	80	67

NQF Level 3

		Discipline in mathematical sciences			Focus of integration		
Topics	Subject outcomes	Maths	Applied Maths	Statistics	Within Maths science	Between Maths and other subjects	Between Maths and everyday life
Numbers	2	2	2	0	2	2	0
Functions and algebra	5	5	2	0	5	2	2
Space, Shape, and measurements	3	3	0	0	3	2	2
Data handling	2	2	0	2	2	2	2

Financial mathematics	2	1	1	0	1	2	2
Total	14	13	5	2	13	10	8
%	100	93	36	14	93	71	57

NQF Level 4

		Discipline in Mathematics			Focus of integration		
Topics	Subject outcomes	Maths	Applied Maths	Statistics	Within Maths	Between Maths and other subjects	Between Maths and everyday life
Numbers	2	2	2		0	2	0
Functions and algebra	5	5	5		0	5	3
Space, shape, and measurements	3	3	3		0	3	0
Data handling & probability models	3	0	0		3	3	3
Financial mathematics	1	1	1		0	0	1
Total	14	11	11	3	13	9	7

%	100	79	79	21	93	64	50

The tables above indicate the focus of integration with Math science count of 93% in all levels, indicating intra-disciplinary integration. The importance of integration across subjects is to showcase the mutual relevance of discipline to each other, by developing connections, and assisting in student's critical development (Umigiraneza, Bansilal & North, 2018). Some of the benefits of integration include understanding motivation, student engagement, and the application of mathematics to concepts in other subjects (Umigiraneza, Bansilal & North, 2018).

NCV Mathematics curriculum has an integration of knowledge that focuses on a weakening of school Mathematics boundaries, rather than transferring knowledge outside of Mathematics. For instance, integration links the aspects of trigonometry, algebra, and calculus. The field of Mathematics Science in NCV Mathematics content remains strongly classified concerning contents outside the field. However, there is a weakening of classification within the field itself. Table 5.5 shows 67%, 57%, and 50% for Level 2, Level 3, and Level 4 respectively, of inter-discursive integration and 80%, 71%, and 64 % if inter-disciplinary integration. It appears that Mathematical Science is insulated as a field of study. There is an indication of a strong connection between daily knowledge and some connection between the science subjects field.

4.4 Part B: Lecturers' interpretation of the curriculum document

The previous section presented the analysis and findings of the study from the curriculum documents. This part is the presentation of the interview analysis:

(a) How is the design and structure of NCV Mathematics curriculum?

(b) How do lecturers interpret and implement the NCV Mathematics curriculum?

The participants comprised two females and three males, all within the age bracket 26-46. In terms of qualifications, the participants had Electrical Engineering, Mathematics, Statistics and Economics, with work experience varying from 2.10 years. Table 5.8 summarises the participants' demographics.

Table 4.7 Lecturers' demographic characteristics

Lecturer	Gender	Age	Qualifications	Lecturing experience
Zodwa*	Female	31-35	N Dip Electrical Engineering BTech Electrical Engineering PGCE Mathematics Bed Honours Mathematics	Three years
Sizwe*	Male	26-30	BSc Applied Math & Statistics Masters Electronics Engineering	Two years
Nokthula*	Female	31-36	NDip Electrical Engineering Honours Financial Acc NPDE Management in Education	Eight years
Sam*	Male	31-36	BSc Applied Mathematics, economics and statistics	Ten years
Mandla*	Male	41-46	NDip (Nated Engineering). NPDE Management in Education	Eight years

(*) Not their real names

Educator's beliefs and experiences plays a huge role in curriculum interpretation (Remillard, 2005). On the same curriculum, they may apply different meanings and

reasoning when enacting the same curriculum Makumane & Khoza, 2020). The analysis is based on how lecturers interpret the curriculum's purpose, structure, content, the challenges which they encounter, as well as the way in which they conduct teaching in relation to such content.

Knowing what teachers want to include in the curriculum, how to reach those decisions, and what they think they are trying achieve by teaching specific content, is an important aspect to determine in understanding their decision-making (Harris & Reynolds, 2018). The analysis is presented by first giving the biography of participants. The selected lecturers differ in their lecturing experiences. They ranged from beginners to experienced lecturers. They also had different educational backgrounds, when it came to their ability to teach, where interpretation of the curriculum would be different.

Teachers' experiences play an important role in the successful implementation of teaching and learning. Knowing how teachers think and experience the curriculum is a necessary precursor to involving them in exploring their own process of curriculum design and how they aim to develop students' knowledge through this process (Harris & Reynolds, 2018).

Lecturers have different experiences ranging from qualifications to years of teaching. Therefore, the curriculum is often interpreted and transformed differently. According to Hunsander, Zorin and Thompson (2015), differences in curriculum perspectives may have an impact in achieving the goals of the curriculum designers. Some goals may not be achieved as anticipated.

4.4.1 Analytical tool for the interviews

Analytical Tool 1

The first interview question was analysed using Graven's (2002b) analysis of the original C2005 GET curriculum for Mathematics, in which she identified four different orientations to Mathematics:

Orientation 1: Mathematics for critical democratic citizenship, allowing learners to critique mathematical applications in various social, political and economic contexts.

Orientation 2: Mathematics as relevant and applicable to the aspect of everyday life and local context.

Orientation 3: Mathematics for inducting learners into what it means to be a mathematician, to think mathematically, and to view the world through a mathematical lens.

Orientation 4: Mathematics involves conventions, skills, and algorithms to master to gain access to further studies.

(a) What is your understanding of the NCV Mathematics curriculum, what is it?

The aim of the above question was to ascertain how lecturers understand the curriculum. This is what they had to say:

Table 4.8: Lectures' description of NCV Mathematics curriculum

Lecturer	Response description	Orientation
Zodwa	It prepares learners to be critical thinkers, using a learner-centred approach.	Orientation 1 and Orientation 3
Sizwe	It prepares learners to go to tertiary level	Orientation 4
Nokthula	It is a combination of high school Mathematics and tertiary Mathematics	Orientation 4 and some element of Orientation 1
Sam	It produces learners that are critical thinkers using a learner-centred approach.	Orientation 1 and Orientation 3
Mandla	The curriculum caters for different fields and requires learners to be critical thinkers.	Orientation 1 and Orientation 3

From the above table, it is evident that Orientation 1 is more dominant. The way lecturers define the NCV Mathematics curriculum is similar to the definition sated in the curriculum document. However, what can be observed is that Orientation 2 is absent. Thus lectures do not view the curriculum as a relevant subject in everyday life. Drawing upon Bernstein's (2000) concept of classification and framing, the lecturer's responses indicate a well-divided and clear boundaries between a subject matter and everyday life, which shows a strong classification of the subject. A key aspect of classification in this study is that it implies a recognition rule, which is a rule where lectures are able to recognise the speciality if the context of the subject that they are teaching.

On a general level, in the first question, lectures do not give a clear definition or understanding of what the curriculum is. In Bernstein's (2000) terms, lack of understanding might emanate from the situation where the classification of the knowledge area in the curriculum is weak (Bernstein, 2000).

Analytical Tool 2

Bernstein's (2000) notion of framing and classification served to explain why lecturers interpreted and implemented the curriculum the way they do. The first research question asked lecturers to describe their own understanding of the design and structure of the intended curriculum. Under this main question were two sub-questions, the first seeking to establish the lecturers' understanding of the NVC Mathematics, while the second one seeking establish their own perceptions regarding the purpose and scope of the NVC Mathematics. During the interview, the participants were asked:

(b) How do you view the purpose, nature and the scope of the NCV Mathematics curriculum?

These questions provided insights into understanding how lecturers understood the purpose and the aim of NCV Mathematics. Lecturers have different ways of describing the

purpose of NCV Mathematics. The common description was that they did not understand what the purpose of NCV Mathematics was. Participants are cited verbatim below:

Researcher: *What is your understanding of the NCV Mathematics curriculum, what is it? How do you view the purpose, nature and the scope of the NCV Mathematics curriculum?*

Sizwe: *I failed to find the purpose of NCV Math curriculum, because it involved lots of things, other things you can see that students do not need them. There are some sections that are advance for the students' level. Other sections are found in university curriculum, yet students are having a challenge of being accepted by the university due to the structure of NCV. Therefore, I fail to find the purpose of NCV Mathematics curriculum.*

In view of above response, one would then ask, how do they implement something which they do not understand? Failure to understand the curriculum might lead to ineffective implementation. In this response, classification and framing seemed to be weak, the curriculum involves lot of things which leads to poor recognition rule.

Researcher: *What is your understanding of the NCV Mathematics curriculum, what is it? How do you view the purpose, nature and the scope of the NCV Mathematics curriculum?*

Nokthula: *I don't know what the purpose was. I don't find the purpose. The scope is too strong for the type and calibre of learners that we are teaching. We are teaching students from different grades with different level of understanding…*

In the interviews, NCV Mathematics emerges as something understood to be without purpose. Despite several lecturers trying to understand its intended purpose, many of them do not understand what the purpose or the intentions of the curriculum designers are, since it involves lots of things that are difficult for students. This experience of lecturers is an expression of them finding it difficult to clearly understand the recognition rule. Contributing to this is the fact that NCV Mathematics contains dual definition, which defines the curriculum as a weakly and a strongly classified curriculum.

Lecturers felt that the curriculum was not well considered when it was designed. In different ways, they are questioning not only how to interpret and implement it, but the importance and necessity of difficult topics and sections that hinder the progress of the learners. Teachers require opportunities to learn about the meanings of policies and their implications for practice (Cohen & Hill, 2000).

The third interview question asked the following question:

(c) How do you find the teaching NCV Mathematics, what are the challenges that you encounter in teaching NCV Mathematics?

The aim of this question was for lecturers to reflect on their teaching practices. According to Van Manen (1995), teacher reflection is divided into the technical, practical, and critical. The technical reflection level occurs when teachers reflect to develop knowledge and skills that help maintain the order necessary to achieve educational goals (Van Manen, 1995). Practical reflection is when teachers worry about applying what they learn in school to classroom situations, it can be even more frustrating if they do not understand all the concepts in the curriculum (Khoza, 2016). Critical reflection refers to where teachers reflect deeply on both power relationships and behaviours that may seem important in the present situation, but may problematic in the future (Adler, 1991).

From the participant's responses, it was clear that multiple experiences existed, with regards to the interpretation and implementation of the NCV Mathematics curriculum. Although the interview questions did not ask about students, when they expressed their experiences and challenges, they mentioned their students. These comments are important in the sense that they affect the implementation of the intended curriculum. Most of the comments were negative. Some lecturers had concerns about the language of instruction. Most of the lecturers and students are English second language speakers, with poor English. Lecturers mentioned that students fail to follow the instructions and solve problems due to language.

I identified four important findings that pose a challenge in the implementation of NCV Mathematics, namely: (a) instructional language is a barrier; (b) students' lack of mathematical background; (c) teaching students from different levels/grades in one class and; (d) lack of support from relevant authorities.

4.4.2 First challenge: Instructional language is a barrier

Lecturers have raised several challenges in implementing NCV Mathematics, amongst which was the language barrier. NCV lecturers feel that students are struggling if not failing to understand instructions, and they have an inability to answer test and exams due to language. Almost all NCV mathematics lecturers and students are English second language speakers. Hence, there are language and communication problems in learning Mathematics as a second language. The language of instruction plays a decisive role not only in the realisation of communication and mutual understanding between teachers and students, but also in the educational development of students (Ejieh, 2004). The following are the sentiments share by lecturers.

Researcher: *How do you find the teaching NCV Mathematics, what are the challenges that you encounter in teaching NCV Mathematics?*

Zodwa: *Another challenge is English; our students do not understand English. If I teach in my vernacular language, I am not abiding by the rules of the college. But If I teach in my vernacular language, I am assisting a child, for example, they will understand if I say "Siyaphindaphinda" we are doing multiplication. When they get to exam there will be no "siyaphindaphinda", there will be multiplication.*

Researcher: *How do you find the teaching NCV Mathematics, what are the challenges that you encounter in teaching NCV Mathematics?*

Sizwe: *Most of our students are from rural areas and from informal settlement and English is hard for them.*

4.4.3 Second challenge: Lack of Mathematics background

There is marked concern among all interviewed lecturers that students lack basic mathematical knowledge. A study conducted by Mthethwa (2013) revealed that poor Mathematics background affected the implementation of the curriculum, which leads to poor performance. Ngoveni (2018) discovered that limiting factors in Mathematics achievements are linked to students who did Mathematical Literacy in high school and have no background in pure Mathematics. For example:

Researcher: *How do you find the teaching NCV Mathematics, what are the challenges that you encounter in teaching NCV Mathematics?*

Nokthula: *It is challenging to implement NCV Mathematics, students are used to be spoon fed, they want a lecturer to do everything for them, yet the curriculum is learner-centred. If I follow a learner-centred approach, students are failing, and they don't understand Mathematics due to their poor Mathematics background.*

Lecturers indicated that for students, particularly in Level 2, lack of Mathematics content knowledge from previous level/grade. These responses revealed that the lack of Mathematics background has an impact on the way in which lecturers implement the curriculum.

Researcher: *How do you find the teaching NCV Mathematics, what are the challenges that you encounter in teaching NCV Mathematics?*

Mandla: *Students failed to understand the content, because they lack Mathematics background. They are coming from different levels with no Mathematics. The college must select students with Mathematics background.*

Another challenge that came out is that lecturers are teaching students that come from different levels and different grades with different levels of understanding. Mandla is of the view that there ought to be an appropriate selection criterion in order to select students with an appropriate educational background and/or interest in NCV Mathematics. There must be a mechanism to recruit and select suitable qualified students for the programme.

4.4.4 Third challenge: Teaching students from different grades with different level of understanding

According to the NCV policy document, the entry requirement for NCV level 2 is Grade Nine. The Level 2 enrolments have a combination of students with Grade Nine, high school drop-out from Grade 10-12, and failed Matric. Level 2 classrooms harbour students with different levels of education. Lecturers highlighted this as a challenge. The NCV programme enrols large numbers of students with different academic readiness levels, thereby requiring lecturers to teach a very different groups of students in the same class (DHET, 2012). The following are some of the sentiments shared by some participants:

Researcher: *How do you find the teaching NCV Mathematics, what are the challenges that you encounter in teaching NCV Mathematics?*

Zodwa: *We have students who are old, and they did not do Mathematics in school. They are coming from different grades, others last attended school many years ago. It becomes a challenge to teach them, because you have to teach old dog new tricks.*

According to Ngoveni (218) and Buthelezi (2018), lecturers find it challenging to teach students whose academic backgrounds varies, TVET classrooms are filled with students of different academic backgrounds as well as a mixture of learning abilities.

***Researcher**: How do you find the teaching NCV Mathematics, what are the challenges that you encounter in teaching NCV Mathematics?*

***Sizwe:** The students we are teaching in Level 2 are coming from different grades. They have a different level of understanding. Others are doing Mathematics for the first time. They have been doing Mathematics literacy in high school. They are very slow, and they ended up being left behind.*

According to Bernstein (1996) recognition rules at the level of the student are means by which a student is able to recognise the specialty of the context they are doing. The recognition enables the proper realisation rule of putting things together. In the view of the above statement by Sizwe, students in Level 2 are unable to produce the legitimate text of the required discourse, due to poor Mathematics background. Hence, the realisation rule is failing. The possession of the realisation rule is reflected in the ability to write the expected text in the context (Machaba, 2017).

***Researcher:** How do you find the teaching NCV Mathematics, what are the challenges that you encounter in teaching NCV Mathematics?*

***Mandla:** Students failed to understand the content because they lack a Mathematics background. They are coming from different levels with no Mathematics.*

What has been revealed by lecturers concurs with the observation made by Buthelezi (2018), who described the unforeseen circumstances in NCV Curriculum. She reported that TVET classrooms has students over the age of twenty, with a mix of learning abilities, as well as students of different educational levels. These students can be affected emotional and psychological. Another unforeseen circumstance is that the standard of subjects in the NCV qualification was perceived by lecturers as being higher than the targeted students, and needed to be revised, due to its complexity (Buthelezi, 2018). According to Acharya (2017), Students who lack enough prior knowledge do not want to learn, and cannot succeed at the other levels.

4.4.5 Fourth challenge: Lack of support from the relevant authorities

With respect to the challenges, lecturers raised concerns that there is no support from the campus and college management. They claimed that they need tutors to assist students. The management does not address their professional needs. There are no workshops for developing NCV Mathematics lecturers with Mathematics content knowledge, especially for those lecturers who did not specialise in Mathematics. In their own words, this is what some of them had to say:

Researcher: *How do you find the teaching NCV Mathematics, what are the challenges that you encounter in teaching NCV Mathematics?*

Nokthula: *We ask for assistance, but in most cases, the Department does not offer any assistance. The help that we ask for is to have tutors in our class. That has never happened because the college is out of funds. The college should have a way of motivating students that have passed the previous level. They should hire them to assist other students as tutors. I feel like the college is failing us in terms of assistance.*

Researcher: *How do you find the teaching NCV Mathematics, what are the challenges that you encounter in teaching NCV Mathematics?*

> ***Mandla:*** *Management needs to select lecturers with Mathematics degrees to teach NCV Mathematics. The lecturers need to be provided with training in sections like data handling and statistics and the calculation of tax tables. Those sections are a problem to most lecturers because they did not major with Mathematics.*

The above view indicates that some of the lecturers are not Mathematics specialists. However, according to RSA (2013), a professionally qualified TVET lecturer in South Africa must have a solid knowledge base in the subject and must have professional qualifications to manage teaching and learning. They are required to have expertise in at least three

domains, namely academic or subject matter knowledge, pedagogy, and workplace qualifications and experiences (McBride, Papier & Needham, 2009; Smith & Grace, 2011).

In this study, the way in which the NCV Mathematics knowledge is organised demands a certain criterion or a special recognition and realisation rule of lecturer's pedagogical practices. If lecturers are not officially trained to teach NCV Mathematics, this raises the question as to the recognition and realisation rules on which they reflect. The description of recognition and realisation rules by Parker (2006), drawing from Bernstein, indicated that recognition rules are criteria (special relationship) for making distinctions, for distinguishing the specialty of a thing/ a practice/ a specialisation/ a context, namely, that which makes it what it is.

These responses revealed professional development to be one of the critical elements that influence both lecturers' interpretation and implementation. The findings of this study concur with Mthethwa (2013), who discovered that teachers with limited Mathematics content may have difficulty dealing with certain sections that requires some knowledge of mathematics to produce a legitimate curriculum. In the same way, Ngoveni (2018) indicated that lecturers are complaining about the shortage of subjects' meetings and workshops, which can ballast their skills. Lecturers believe that workshops and subjects meetings help addresses some of the gaps that exist among them (Ngoveni, 2018).

Another study conducted by Umigaraneza, Bansilal and North (2018) revealed that teachers who participate in refresher courses have improved mathematics knowledge for teaching and are more likely to use the curriculum than teachers who did not participate. According to Ngxola (2013), poor teacher training and insufficient resources have been the main obstacles limiting the implementation of the curriculum in schools across various subject areas. The poor training created a significant content knowledge gap between knowledge teachers' development during their own schooling and teacher training and the knowledge they need to teach the content adequately (Ngxola, 2013).

4.4.6 Lecturers' approaches to overcoming the identified challenges

(d) How do you deal with the challenges that you have identified?

In response to the interview question of how they deal with the challenges that they have identified, the participants indicated that they allow students to teach or do presentations, using the learner-centred approach. Others have resorted to teaching students how to answer examination questions without teaching the actual content. The following are the approaches share by lecturers:

Researcher: *How do you deal with the challenges that you have identified?*
Sam: *I teach them how to answer tests and exam questions. There is no time to fill the gap. If I do that, I will end up not completing the syllabus. I introduce the topic and teach some basics that are required in that section. After that, we do the question papers for class exercises to get used to questioning and know how to answer in the tests or exams.*

It is evident from this response that the lecturer is training students to be good examination candidates, by teaching procedures and rules to be followed in the Mathematics examination. However, the use of rules and procedures in Mathematics has been discouraged, as it enhances instrumental understanding" (Machaba, 2017). Van de Walle (2007) attests that "procedural knowledge of Mathematics is knowledge of rules and procedures that one used when carrying out routine mathematical tasks and includes the symbolism that is used to represent Mathematics.

This response implies that the lecturer has not acquired a good practice for Mathematics teaching (recognition rule), that enables him to carry out these practice (realisation rule) The implication in the approach highlighted by Sam is that during implementation, the lecturer altered the curriculum to fit his goal. This might disconnect the intended and an attained curriculum, which might have a negative impact on the prescribed curricular goals (Makumane & Khoza, 2020). This approach indicates that the lecturer wants his students to pass the subject by filling the students with information that students receive, memorise, and repeat. According to Bervens et al. (2014), such an approach jeopardises the quality of education.

Researcher: *How do you deal with the challenges that you have identified?*
Sizwe: *I teach them even the things that are not in the curriculum, so that they can have the foundation of Mathematics. By doing that, I am trying to close the gap of what they lacking.*

This response shows that the lecturer is transferring his understanding of mathematical concepts to students. That can be interpreted as a direct teaching. It means that lecturers have more control in the class compared to students over the way in which knowledge is selected, sequenced, and evaluated in the classroom. In Bernstein's terms, both classification and framing are expressed as being strong in this case.

Researcher: *How do you deal with the challenges that you have identified?*
Nokuthula: *Firstly, I found out their last grade, so I can see what grades are in my then I adjust my teaching accordingly.*

Data analysis shows that lecturers use a variety of approaches to overcome challenges. Lecturers are informed by emerging needs in determining the suitable way to overcome the challenges. Thus, lecturers' personal reasoning shapes the way they impart knowledge to learners by using what Khoza (2013, 2019) called ideological-ware, which is the resource that exist in their minds, controlling teaching or actions to achieve the outlined goals. Others are starting from the basics, where they teach in order to close the gap. Such an approach shows that lecturers draw from their cognitive knowledge to teach the content.

Overall, as alluded to by the participants, the NCV programme attracts large numbers of students with different academic readiness levels, thus requiring lecturers to teach a very diverse cohort of students in the same class (DHET, 2012). TVET classrooms often involve students at different educational levels and with mixed learning abilities (Buthelezi, 2018). For some students, the content is challenging to master. Grade Nine students are the most challenged, due to the lack of foundational Mathematics. Given this scenario, lecturers need to possess high standards of knowledge on the methods to deliver the content.

4.2 Factors affecting the implementation of NCV Mathematics

The aspect of factors affecting the implementation of the curriculum was not directly asked of the participants, but it emerged throughout the discussions with them, hence, it is important to highlight them. The data analysis indicated some differences among lecturers in how they conduct their teaching. There are factors, such as time and personal factors, which hinder the flow or the proper implementation of the curriculum. Personal factors, such as qualifications and skills, contribute to improper implementation of the curriculum. Indeed, it has been noted that one in every five lecturers at a South African vocational college possesses no academic or vocational qualification to teach (i.e., at least three years' full-time university tuition with an NQF grade of at least six or higher) (Zinn, Raisch & Reimann, 2019). For some of the lecturers, Mathematics is not their speciality, but they are appointed to teach Mathematics due to their engineering background. They lack knowledge in some of the topics within the curriculum, and tend to leave these out. This personal factor highlights weak framing.

Fejes, Nylund and Wallin (2019) assert that for a curriculum to be implemented successfully, time needs to be offered for teachers to actually conduct the implementation, otherwise there is a risk of teachers construing the curriculum as superficial and forced upon them. NCV Mathematics lecturers complained about time, because they teach students with no Mathematics background. Before they get to the core of the curriculum, they need to fill these gaps first.

Disruptions such as non-curricular activities are scheduled during teaching and learning time. Time for such activities is not allocated in the curriculum document. The college tolerates such activities to a large extent, without compensating the time lost. The views of the lecturers could be understood in terms of weak classification and framing (Berstain, 2000), with elusive recognition and realisation rule. Great demands are placed upon lecturers' shoulders to interpret and implement the curriculum. Lecturers feel overwhelmed.

4.3 Lecturers' overall perception of the NCV Curriculum

(e) What would you change or add to the current NCV Mathematics curriculum?

This theme emanates from the discussion about what the lecturers would change or add to the current NCV Mathematics curriculum. In response to this, they all suggested the need for some changes in certain sections of the curriculum, particularly in Level 4. They also felt the entry requirements need to be revised, since students with Grade 9 have poor Mathematics background. This is how they responded to the issue:

Researcher: *What would you change or add to the current NCV Mathematics curriculum?*
Nok'thula: *Level 2 and Level 3 are ok, but something needs to be done in Level 4. There is a lot of new work. Circle theorems are entirely new in Level 4. There are so many new theorems that need to be done, and it becomes too much for a teacher and a student. Some of the content in Level 4 needs to be broken down and be introduced at Level 3.*

The responses from the participants clearly indicate that lecturers as the implementers of the curriculum should be involved in the consultation, design, and development process. This concurs with Maphalala and Mpofu (2018), who argue that teachers are the curriculum drivers, and interact with the curriculum daily. This means that they are better positioned to see what works and what does not work in a classroom situation concerning the outcomes. For this reason, they should be at the forefront of the curriculum transformation. Phaeton and Stears (2016) assert that teachers must understand the curriculum requirements as clearly as possible to implement the curriculum as intended correctly.

Researcher: *What would you change or add to the current NCV Mathematics curriculum.*

Sam: *First thing to change is the entry requirement of NCV. Grade Nine is too low. Secondly, in the curriculum, especially in Level 4, I will remove-circle theorems; students*

fail that section every year. I have been teaching for ten years now. Every year students fail dismally on that section. Thirdly, calculation of probabilities, teachers need to be trained in order to teach that section. It is very difficult.

From the curriculum document analysis, the visible actual focus of NCV Mathematics is integration. NCV Mathematics seems to have broadened the focus of school Mathematics by encompassing mathematics, applied mathematics, and statistical mathematics. It can be viewed as a knowledge field of Mathematics, rather than a single discipline. The participants of this study regarded this as a complicated combination.

In this regard, teachers are the ones who work directly with students, who translate and shape curricular goals and theoretical ideas into classroom practice and hence, they need to develop and grow in ways that will help serve all their students well (Timperly, Wilson & Fung, 2008). According to Buthelezi (2018), for some students, the work is manageable, while others find the content being dealt with very hard. Students who are challenged the most are those in Grade 9, because they are young and the content is pitched to a higher level. In light of this, this study recommends that the curriculum developers design a bridging course to help students.

4.4 Conclusion

To conclude this section, the study found that in NCV Mathematics curriculum lecturers do not have much power or control over the curriculum it is strongly classified. According to Harrell (2010), classification is associated with power and framing is associated with control. A strong frame referred to a rigid curriculum in a predetermined order that was to be completed within a specific time, whereas a weak frame suggests that the teacher in control of selecting and pacing content, according to the level of the learner. Framing, on the other hand, refers to pedagogy, which explores the way in which content is taught and organised.

In this study, lecturers form part of framing, and do not have power over the curriculum because they have to implement it as it, indicating weak framing. However, they are challenged in understanding the purpose of the curriculum, teaching students from different grades alongside the misalignment in the curriculum content. The stated challenges force them to weaken the frame in order to accommodate learners by selecting and pacing content according to the level of each individual student.

4.5 Chapter summary

This chapter presented the data analysis of the curriculum document and the semi-structured interviews. The analysis of the curriculum document had revealed that NCV Mathematics curriculum is a structure of applied Mathematics, including problem-solving and Mathematical modelling, with various context including real-life context. It is an integrated-type of curriculum that encourages learner-centred approach. The interviews have shown different views about the curriculum. The major highlights were the challenges that lecturers encounter during implementation.

The next chapter will discuss the finding and make recommendations.

CHAPTER FIVE

5. SUMMARY OF THE STUDY, KEY FINDINGS AND RECOMMENDATIONS

5.1 Introduction

The purpose of this study was to explore lecturers' interpretation and implementation of the intended NCV Mathematics curriculum at a TVET college. This chapter thus presents the summary of the study, key findings, and recommendations made. The main findings from the curriculum document analysis and semi-structured interviews of the study will be discussed and thereafter, followed by suggestions for further research and recommendations.

5.2 Summary of the study

Chapter One highlighted the introduction of the study, the reasons that motivated the study, the background, objective, research questions and critical questions.

Chapter Two had two parts. Part A reviewed related literature on the TVET curriculum, NCV and Mathematics curriculum, Mathematics curriculum interpretation and implementation. The scarcity of literature in NCV Mathematics curriculum provoked further the pursuance of this study. Part B presented the frameworks underpinning this study. The rationale behind the chosen frameworks, its relevance and the link between the framework and analysis tool was explained. Chapter Three described the methodological aspects of the study. The qualitative case study enabled me to explore lecturers' interpretation of the NCV Mathematics curriculum.

The chapter went further to discuss data collection procedures, instruments and data analysis strategies employed in the study. Furthermore, ethical issues were discussed, and data was collected using document analysis and semi-structured interviews. The

trustworthiness of the study was discussed and was accomplished through the techniques under credibility, triangulation and confirmability.

Limitations were also discussed.

Chapter Four presented, analysed and discussed the results that were collected through document analysis and semi-structured interviews. The findings of the study were presented based on the themes that emerged from the data.

Chapter Five presents the main findings from the curriculum document and semi-structured interviews of the study, followed by recommendations, as well as suggestions for further research.

5.3 Discussion of the key findings

This section discusses the major findings from the NCV Mathematics curriculum document and the semi-structured interviews.

5.3.1 Major findings from the NCV Mathematics curriculum document

The NCV Mathematics curriculum documents were analysed using Graven's (2002b) analysis of the original C2005 GET curriculum for Mathematics, in which she identified four different orientations to Mathematics. The analysis showed that the definition presented in the curriculum document corresponds with Orientation 1 and Orientation 3, while Orientation 2 is less covered, and Orientation 4 is not covered. This implies that NCV Mathematics is an integrated type of curriculum, which is weakly classified.

In the integrated type of curriculum, reference is made to the relation with other subjects. The NCV curriculum exhibits an integrated curriculum as it blends in mathematics, applied mathematics, and statistics. However, the focus of integration is within mathematics than other subjects and, everyday life. Integrated curriculum allows teachers to deal with two or more of the knowledge discipline to explore the best topic that can be taught simultaneously and to design the best teaching activities (Al-Mutawah et al. 2022).

Integration can make students see the shared concepts and factors in meaningful and enriched way.

In all levels, there is an indication of intra-disciplinary integration. The NCV Mathematics curriculum possessed characteristics and structure of applied Mathematics, including problem-solving and mathematical modelling within various contexts, including real life. It also describes NCV Mathematics as a practice and systematic way of thinking about viewing and structuring the world and communicating in the world. According to Al-Mutawah et.al.(2022), the concept of intra-disciplinary integration emerged to the existence in business industry, medicine, and educational fields to bridge the gap between market needs and insufficient graduated labours' skills and to eliminate the negative consequences of such economical phenomenon

The inclusion of context in NCV Mathematics can be seen as one way of crossing boundaries between mathematical and non-mathematical discourse, thereby extending more opportunities to every student (Mthethwa,2019), those who want to take a vocational route and those who will major in mathematics in further studies. The manner in which NCV Mathematics is designed and presented, attempt to draw interest of learners to do Mathematics without fear, to access Mathematics and to understand mathematics in real life situations. Much Mathematics teaching requires the interaction between the understanding of mathematical knowledge and pedagogical understanding, which impact on students learning. Lesteri and Juniati (2018) asserted that having knowledge of content and teaching means that teachers ought to be able to utilise various resources and be able to evaluate the advantages and disadvantages of representation used to fit the needs of students.

Similarly, to Mathematics Literacy (Bowie & Frith, 2006) opine that there are two major forces that led to the introduction of Mathematical Literacy. These forces are: (i) the democratisation of mathematics, that is, to provide greater access to mathematical skills for more people and (ii) mathematics for democracy, that is, the need for more people be able to use mathematics in order to participate in the modern world of technology. However, it poses a question as to whether all who gain access to mathematics through

Mathematical Literacy will, in fact, use mathematics effectively and efficiently to participate in this context.

The definition of NCV Mathematics involves two different concepts, based on different classifications. It is defined as a discourse with unique language and symbolism different from everyday life. Here, the classification is strong, with an explicit link to mathematical knowledge. On the other hand, it is defined as a subject that can develop weakly classified skills and competences. It enables students to be responsible citizens, who are able to solve problems in their social world, and manage life in general. Here, the curriculum gets a weak classification and framing. These two types of definition have led to confusion to the lecturers in understanding the purpose of curriculum. It therefore presents the opportunity for further research.

5.3.2 Major findings from the semi-structured interviews in relation to the research questions

Due to COVID-19, which requires physical distancing, semi-structured interviews were held via Zoom. Nehls, Smith and Schneider (2015) perceived online video conferencing interview to be one of the fastest and most reliable means of collecting qualitative data from respondents just like a face-to-face interview, it communicates in real-time via audio and video technologies such as Skype, Zoom, Google Meet. Video conferencing interviews allow the same system of flexibility as do telephone interviews, where respondents stay in the comforts of their homes and workplaces (Adom, Ojei & Adu-Agyem, 2020). During the semi-structured interviews, NCV Mathematics emerges as something unclear in terms of its purpose. Most of the lecturers (three of the total) argue that they don't understand what the purpose or the intentions of the curriculum designers is, since it involves many aspects that are difficult for students. This experience shows how they find it difficult to clearly express the recognition rule. Contributing to this is the fact that NCV Mathematics contains a complex definition, that is as a weakly and a strongly classified curriculum.

I provided lecturers' interpretation of the curriculum using the construction of recognition and realisation rules. The data discussed reveals that due to time constraints, lecturers are sometimes forced to just give students rules and procedures to do NCV Mathematics. In Bernstein's terms, that implies that the pedagogical practices in NCV Mathematics are views as Mathematics for rules and application of procedures. Bernstein refers to this type of teaching as visible pedagogy, which is associated with performance curriculum. However, the definition of NCV states that NCV Mathematics ought to enable learners to do reasoning and problem-solving. Bernstein refers to this type of teaching as invisible pedagogy, which is associated with competence curriculum.

Thus, lecturers indicate a tendency towards inconsistency in their pedagogy practices, where they fail to achieve a learner-centred model suggested in the curriculum. In Bernstein's terms, it appears that NCV Mathematics lecturers' recognition and realisation rules seemed to be reflecting old ways of teaching Mathematics as rules and procedures. It shows that lecturers have not established what is accepted as a good Mathematics teaching practice.

From the participant's responses, it was clear that multiple experiences existed, with regards to the interpretation and implementation of the NCV Mathematics curriculum. Although the interview questions did not ask about students, when they expressed their experiences and challenges, they made comments about their students.

These comments are important in the sense that they affect the implementation of the intended curriculum. Most of the comments were negative. Some lecturers had concerns about the language of instruction. Most of the lecturers and students are English second language speakers, with limited English. Lecturers mentioned that students fail to follow the instructions and solve problems because of the language.

I identified four important findings that pose a challenge in the implementation of NCV Mathematics, namely: (a) instructional language is a barrier; (b) students' lack of Mathematics background; (c) teaching students from different levels/grades in one class and; (d) lack of support from relevant authorities.

With respect to these challenges, lecturers raised concerns that there is no support from the campus and college management. They said they need tutors to assist students. The management does not address their professional needs. There are no workshops for developing NCV Mathematics lecturers with Mathematics content knowledge, especially for those lecturers who did not specialise in Mathematics.

When it came to lecturers who did not specialise in Mathematics, the implication is that they are unable to recognise the speciality of the content. This then raises a question as to how are they selecting the pedagogical practice. Although I couldn't observe their teaching in practice, I presumed that they might fail to put mathematical practices as captured in the curriculum, since they were unable to recognise the content.

5.4 Recommendations for curriculum developers and college management

Mokone (2011) argues that curriculum developers ought to design a bridging course to help students with the NCV Programme's demands. Summing up the interviews, lecturers believed that curriculum developers should indeed design a bridging course for NCV. Most students fail to cope with the demands of the NCV curriculum. Therefore, it is recommended that entry requirements be revised. There must be selection criteria for NCV Engineering students; where Mathematics and Physical Science ought to be a prerequisite.

Other lecturers feel that they need training in topics like Statistics and probabilities. Lecturers feel that they are teaching a subject that is not their specialisation. Ndwandwe and Dlamini (2013) emphasise that the lecturers ought to be adequately qualified to teach specific skills and content to students to the satisfaction of the qualification requirements as positioned by subject aims and objectives.

It is recommended that the college management appoint the suitable and qualified lecturers to teach NCV Mathematics. Moreover, the college ought to promote continuous professional development in order to capacitate lecturers with both pedagogical and content Mathematics knowledge. In-house trainings and subject meetings ought to be held

in order to address the knowledge gaps and share teaching strategies, which is not currently underway, based on the evidence gathered here.

5.5 Limitations

The study is small-scale, and thus its findings and results are subjective, personal, and contextual, and therefore cannot be generalised to a larger population of TVET, but can only be used for the sake of transferability, rather than generalisation.

Researchers have other means of carrying out their research activities when they have geographical constrains to collect data using traditional data collection procedures (Nehls, Smith & Schneider, 2015). At the time of data generation, the country faced a hard lock down due to COVID 19, where there was total closure of all schools, including TVET colleges and universities (Mhlanga & Moloi, 2020).

As a result of the pandemic, there was also a major public health crisis that has required dramatic changes in human behaviour. The virus is easily transmitted through direct contact with infected people (through exposure to potentially infective respiratory droplets) and through indirect contact (through fomites –contaminated surfaces in the immediate environment of an infected person or objects used by an infected person) (WHO, 2020). Thus, physical distancing has become a central practice to help combat the spread of the virus. Due to preventative measures such as social distancing and lockdown the traditional procedures for data collection for research such as classroom observation and face-to-face semi-structured interviews are not feasible.

This has caused an expanded use of digital technologies in multiple fields so as to ensure the continuation of obligations, regardless of physical distancing and national lockdowns (Sokhulu, 2020). Working remotely via computer-mediated communication technologies is appropriate in such conditions to generate qualitative data (Adom, Ojei & Adu-Agyem, 2020). The UHSSRC had advised that no fieldwork be conducted; hence I had to cancel class observations, which limited data collection to document analysis and semi-structured interviews, which were held online via Zoom.

Online video conferencing interviews are now one of the fastest and reliable means of collecting qualitative data from respondents, as for a face-to-face interview (Nehls, Smith & Schneider, 2015). It communicates in real-time via audio and video technologies such as Skype, Zoom, Google Meet, Google Duo, Adobe Connect, Apple's Face Time and Google Chat. Video conferencing interviews allow the same system of flexibility as do like telephone interviews, where respondents stay in the comfort of their homes and workplaces.

Nehls, Smith and Schneider (2015) opine that telephone and video interviews, text-based chats administration of electronic survey tools such as electronic questionnaires have considerable success in data generation and could be used during pandemics when the physical movement of researchers proves to be restricted. The initial plan was to have six participants, but due to network glitches one participant could not be reached. Tamrat and Teferra (2020) note that in Africa only 24% of population has access to the internet, however the frequent electricity power cuts, high cost of data and poor connectivity remains deleterious to education, society, and the broader economy. Lecturers were adamant to participate, but since the interviews were online, complained about not having data. The study was required to fund data for all the participants. Conducting interviews online prolonged the timeframe for the interviews and the study. Family responsibilities limit the ability to work from home. Sometimes there is no electricity due to load shedding and cable theft. I don’t have a stable network connectivity.

5.6 Suggestion for further research

This study discovered that not much research has been conducted on the NCV Mathematics curriculum, where more research is required to close this gap. This study was based on lecturers’ interpretation and implementation of the curriculum. Further research is suggested on the students’ experiences with the NCV Mathematics, in terms of the successes and challenges encountered by students in interpreting the curriculum.

5.7 References

(WHO), W. H. (2020, March 15 June). *Coronavirus disease 2019 (COVID-19) Situation Report.* Retrieved from World Health Organisatio: https://www.who.int/docs/default-source/coronaviruse/situation-reports/20200311-

Acharya, B. (2017). Factors Affecting Difficulties in Learning Mthematics by Mathematics Learners. *International Journal of Elementary Education 6(2)*, 8-15.

Adler, A. (1991). The reflective of teacher and the curriculum of teacher education. *Journal of Education for Teaching 17(2)*, 139-150.

Adom, D., Ojei, M., & Adu-Agyem, J. (2020). COVID-19 Lockdown- A Review of an Alternative to the Traditional Approach to Research. *Research Journal in Advance Social Sciencea*, 1-9.

Agrawal, T. (2012). Vocational education and training in India: Challenges, statust and labour market outcomes. *Journal of Vocational Education 64(4)*, 453-474.

Aikenhead, G. (2006). Science education for everyday life. *Evidence-based practice.Teacher College Press*.

Albashiry, N., Voogt, J., & Pieters, J. (2015). Improving curriculum development practices in a technical vocational community college: examining effects of a professional development arrangement for middle managers. *The Curriculum Journal,26(3)*, 425-481.

Aldon, G., Cusi, A., Schacht, F., & Swidan, O. (2021). Teaching Mathematics in the Context of Lockdown: Astudy Focused on Teachers' Praxeologies. *Education Science*, 11-38.

Allmark, P. (2002). "The Ethics of Research with Children". *Nurse Researcher 10(7)*, 1-19.

Al-MutawahM, Mahmoud, E., Thomas, R., Peri, N., & Alghazo, Y. (2022). Maths and Science Integrated Curriculum: Pedagogical Knowledge-Based Education Framework. *Educational Research International*.

Amankwaa, L. (2016). PROTOCOLS FOR TRUSTWORTHINESS IN QUALITATIVE RESEARCH. *Journal of cultural diversity 23(3)*.

Amoo, A., & Swart, A. (2018). The influence of class attendance on the throughput rates of students at a FET colleges in South Africa. *In 2018 IEEE Global Engineering Education Conference(EDUCON)*, 10-14.

Anderson, T., & Elloumi, F. (2008). *Theory and Practice of Online Learning.* Canada: Athabasca University Press.

Annamalai, N. (2019). Using WhatsApp to extend learning in a blended classroom environment. *Teaching English with Technology 19(1)*, 3–20.

Badenhorst, J., & Radile, R. (2018). Poor Performance at TVET Colleges: Conceptualising a distributed instructional leadership approach as asolution. *African Education Review 15(3)*, 91-112.

Basit, T. (2003). The role of the coding in qualitative data analysis. *Education Research 45(2)*, 143-154.

Bernsein, B. (2003). *Towards a theory of educational transmissions.* Routledge.

Bernstein, B. (1971). *On the Classification and Framing of Educational Knowledge.* London: Collier-Macmillan.

Bernstein, B. (1972). Classification and Framing of Educational Knowledge. *Human Context 3,no.2*, 339-361.

Bernstein, B. (1977). *Aspects of the relations between education and production.* London: Routledge.

Bernstein, B. (1996). Pedagogy, symbolic control anf identity. *British journal of Sociology of Education 18(1)*, 119-124.

Bernstein, B. (1999). Vertical and horizontal discourse: An essay. *British Journal of Education 20(2)*, 157-173.

Bernstein, B. (2000). *Pedagogy,Symbolic Control and Identity.* England: Rowman and Littlefield Publishers.

Bernstein, B. (2018). On the classification and framing of educational knowledge: In knowledge, education, and cultural change. *Routledge*.

Betram, C., & Christiansen, I. (2014). Understanding research: An introduction to reading research. *Van Schaik Publisher*.

Bogdan, R., & Biklen, S. (2007). Research for Education: An introduction to theories and methods. *Boston,MA:Allen and Bacon*.

Bosman, A., & Schulze, S. (2018). Learning style preferences and Mathematics achievement of secondary school learners. *South African Journal of Education 38(1)*.

Bowen, G. A. (2009). Document analysis as a qualitative research method . *Qualitative research journal*, 27-40.

Bowi, L., & Frith, V. (2006). Concerns about the South African Mathematical literacy curriculum arising from experience of Materials developments. *Pythagoras 12(1)*, 29-36.

Braun, V., & Cark, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology 3(2)* , 44-101.

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative research in pyschology, 3(2)*, 77-101.

Buthelezi, Z. (2018). Lecturer experiences of TVET colleges challenges in the post-apartheid era: a case study of united consequences of educational refom in South Africa. *Journal of Vocational Education,70(3)*, 364-383.

Carl, A. (2009). *Teacher Empowerment Through Curriculum Development Practice (2nd ed).* Capetown: Juta.

Chirinda, B., Ndlovu, M., & Spangenberg, E. (2021). Teaching Mathematics during COVID-19 lockdown in a context of Historical Disadvantage. *Education Science 11(4)*, 177.

Choak, C. (2012). Asking questions: Interviews and evaluations. In S. Bradford, & F. Culle, *Research and research methods for youth practitioners* (pp. 90-112). London: Routledge.

Christie, F. (2002). *Classroom discourse analysis: a functional pespective.* London: Continuum: British Library Cataloguing-in-Publication Data.

Clarke, L., & Winch, C. (2007). *Vocational Education (international approaches developments and systems).* London: Routledge.

Cohen, D., & Hill, H. (2000). Instructional policy and classroom performance: The mathematics reform in California. *Teacher College Record 102(2)*, 24-343.

Cohen, D., & Hill, H. (2001). Learning policy: When state education works. *State university Press*.

Cohen, L., & Manion, L. (1994). *Research methods in Education.* London: Routledge.

Cohen, L., Manion, L., & Morrison, K. (2002). Research Methods in education. *Routledge*.

Cohen, L., Manion, L., & Morrison, K. (2011). Surverys longitudinal, cross-sectional and trend studies. *Reasearch Methods in Education 7th Edition* .

Connel, T., Lynch, C., & Wering, P. (2001). *Constraints, Compromises and Choice: Comparing three qualitative research studies*. Retrieved from The Qualitative Report: http//: www.nova.edu/sss/QR/RR6-4/ Connell.html

Cresswell, J. (1998). *Research design: Qualitative inquiry and research design: Choosing anong five traditions.* Thousand Oaks,CA: SAGE publications.

Cresswell, J. (2003). *Research design: Qualitative, quantitative and mixed methods approaches (2nd ed).* Thousand Oaks,CA: SAGE publications.

Creswell, J. (2009). *Research Design Qualitative*. Retrieved November 11, 2020, from Quantitative and Mixed Methods Approaches: www.sagepublications.com

Creswell, J., & Cresswell, J. (2017). *Research design:Qualitative, quantitative, and mixed methods approaches.* London: Sage Publication.

DE. (2018). CONCEPTUAL FRAMEWORK, THEORETICAL FRAMEWORK, STATE OF ART AND REFERENCED FRAMEWORK. *MSC SOCIAL SCIENCE RESEARCH METHODS AND TECHNIQUES*, 1-10.

Denzin, N. (2017). The Research Act. A Theoretical introduction to social methods. *Routledge*.

DHET. (2012). *Statistics on Post School Education and Training.* Pretoria: Department of Higher Education.

DHET. (2013). NCV level 4 Mathematics Subject Guideline. *Department of Higher Education: Subject Guideline*.

DHET. (2013). *White Paper on Post-School Education and Training.* Pretoria: Department of Higher Education and Training.

DHET. (2014). *White Paper on Post-School Education and Training.* Pretoria: Department of Higher Education and Training.

DHET. (2017). *Statistics on Post School Education and Training.* Pretoria: Department of Higher Education.

DHET. (2018). 9th Pan African TVET Colleges Conference. *Department of Higher Education*.

DHET. (2018). *Government Gazette on Minimum Admission Requirements into Higher Education with the NC(V) Level 4.* Pretoria: Department of Higher Education and Training.

DHET. (2019a). *State of the National Address.* Cape Town: Department of Higher Education.

DHET. (2019b). Pricewaterhouse Coopers (PwC) Annual Report. *Department of Higher Education Government Gazette*.

Diab, S., & Sartawi, B. (2017). Classification of questions and learning outcomes statements(los) into blooms taxanomy(bt) by similarity measurements towards extracting of learning outcomes from learning materials. *International Journal of Managing Information Technology*.

DoE. (1998a). *Education White Paper 4: A programme for the transformation of further education an training: Preparing for the twenty- first century education , training and work.* Pretoria: Department of Education.

DoE. (1998b). *National Curriculum Framework for FET Band: Discussion document of education .* Pretoria: Department of Education.

DoE. (2006). *Further Education and Training Act No16 of 2006 Government Gazette No 2946.* Pretoria: Governement Printers.

DoE. (2007). *FET colleges: Institutions of first choice.* Pretoria: Department of Education.

Drijvers, P. (2020). Moving Foward in the Midst of a Pandemic International Lessons for Maths Teachers . *Presentation at the National Academic of Science, Engineering and Medicine*.

Du Plooy, C., Davis, S., & Bezuidenhout, R. (2014). *Research Matters.* Cape Town: Juta and Co.Ltd.

Eisner, E. (1991). *The enlightened eye: Qualitative enquiry and the enhancement of educational practice.* Toronto: Collier Macmillan Canada.

Ejieh, M. (2004). Attitudes of student teachers towards teaching in mother tongue in Nigeria primary schools:implications for planning. *Language,culture and curriculum 17(1)*, 73-81.

Etikan, I., Musa, S., & Alkassim, R. (2016). Comparison of convenience sampling and purposive sampling. *American journal of theoritical and applied statistics,5(1)*, 1-4.

Fjes, A., Nylund, M., & Wallin, J. (2019). How do teachers interpret and transform entrepreneuship education? *Journal of Curriculum Studies*.

Flick, U., & von Kardoff, E. S. (2004). *A companion to qualitative research.* London: Sage.

Fraenkel, J., & Wallen, N. (1993). *How to design and evaluate research in education.* New York: McGraw-Hill.

Fullan, M. (2001). *The New Meaning of Change.* Michigan: Braun Brumfield Inc.

Fuller, A., & Unwin, L. (2003). Learning as apprentice in the contemporary UK workplace: creating and managing expansive and restrictive participation. *Journal of Education and Work*.

Fusch, P., Fusch, G., & Ness, L. (2018). Denzin's paradigm shift: Revisiting triangulation in qualitative research. *Journal of social change,10(1)*, 2.

Gagel, C. (1997). Literacy and technology : Reflections and insight for technology literacy. *Journal of Industrial Teacher Education 34(5)*, 6-34.

Gall, M., Borg, W., & Gall, J. (1996). *Educational Research.* Washington: Longman Publishing.

Gamble, J. (2006). Theory and Practice in the Vocational Curriculum. In M. Young, & J. Gamble, *Knowledge,Curriculum and Qualifications for South African Further Education* (pp. 87-103). Cape Town: HSRC Press.

Grant, C., & Osanloo, A. (2016). Understanding, selecting and intergrating a theoritical framework in disertation research: creating the blueprint for your "House". *Administartive issues journal: connecting education, practice, and research 4(2)*, 7.

Graven, M. (2002b). Coping with new mathematics teacher role in a contradictory context of curriculum change. *The Mathematics Educator*, 12(2), 21-28.

Gumede, L., & Badriparsad, N. (2021). Online teaching and learcing the students; eyes-uncertainity through the COVID-19 lockdown: Aqualitative case study in Gauteng Province,South Africa. *Radiography28(1)*, 193-198.

Gunawan, J. (2015). Ensuring trustworthiness in qualitative research. *Belitung Nursing Journal,1(1)*, 10-11.

Hansen, R. (1995). Teacher socialisation in techological education. *Journal of Technology Education 6(2)*, 34-45.

Harrel, P. (2010). Teaching an integrated science curriculum: Linking teacher knowledge and teaching assignment. *Issues in Teacher Education 19(1)*, 145-165.

Harris, R., & Reynolds, R. (2018). Exploring teachers' curriculum decision making:insight from history education. *Oxford Review of Education, 44(2)*, 139-155.

Hart, C. (2018). *Doing a literature review:Releasing the research imagination.* London: Sage.

Hassaji, H. (2015). *Qualitative and discriptive research: Data type versus data analysis.* Canada: SAGE.

Hoadley, J., & Jansen, J. (2012). *Curriculum: Organising Knowledge for the classroom(3rd).* Cape Town: Oxford Universiy Press South Africa.

Hoadley, U., & Jansen, J. (2013). *Curriculum Organising Knowledge for the Classroom 3ed.* Capetown: Oxford University Press Sourthen Africa.

Hodges, C., Moore, S., Lockee, B., Trust, T., & Bond, M. (2022, June 27). *The differerence between emergency remote teaching and online learning*. Retrieved from https://er.educause.edu/articles/2020/3/the-difference-between-emergency-remote-teaching-and-online-learning

Hoepfl, M. (1997). Choosing Qualitative Research: A Primer for Technology Education Reseachers. *Journal of Technology Education 9(1)*.

Houang, R., & Schmidt, W. (2008). TIMSS international curriculum analysis and measuring education opportunities. *In The 3th IEA International Research Conference (IRC 2008)*.

Hunsander, P., Zorin, B., & THompson, D. (2015,4(1)). Enhancing Teachers'mAssessment of Mathematical Processes Through Test Analysis in Universiry Course. *Mathematics Teacher Educator*, 71-92.

Iedema, R. (1996). 'Save the talk for afetr the listening':the realization of regulative discourse in teacher talk. *Language and Education 10(2)*, 82-102.

Ivinson, G. (2002). Instructional and regulative discourse: A comparitive case study of two classroom settings design to ameliorete boys' underarchievement in English . *School of Social Science Working Paper*.

Kawulich, B. (2004). Data analysis techniques in qualitative research. In Darla Twale (ed). *Journal of research in education 14(1)*, 96-113.

Kean, T., Kannan, S., & Piaw, C. (2018). The Effect of School Bureaucracy on the Relationship between Principals' Leadership Practices and Teacher Commitment in Malaysia Secondary School. *MOJES: Malaysia Online Journal of Educational Science 5(1)*, 37-55.

Kennedy, D., Hyland, A., & Ryan, N. (2009). Learning outcomes and competences. *Introducing Bologna objectyives and tools*, 2-3.

Kessels, J. (1999). A relation approach to curriculum designs. In J van Akker,R Branch,K Gustafson, N Nieveen and T Plomp (Eds). *Design and development methodology in education: Kluwer Academic*.

Khoza, S. (2015b). Student Teachers' Reflection on their Practices of the Curriculum and Assessment Policy Statement. *South African Journal Of Higher Education*, 1-16.

Khoza, S. (2015c). Using curricular spider web to explore a research facilitators' and students' experiences. *South African Journal of Higher Education29(2)*, 122-143.

Khoza, S. (2016). Is teaching without understanding curriculum visions and goals a high risk? *South Africsn Journal of Higher Education 30(5)*, 1-16.

Khoza, S. (2018). Can teachers' reflection on digital and curriculum resources generate lessons? *African Education Review 1(2018)*, 1-16.

Khoza, S., & Biyela, A. (2019). Decolonising technological pedagogical content knowledge of first year mathematics students. *Education and Information Technologies, 25(2)*, 927-941.

Kimani, G., Kara, A., & Njagi, L. (2013). TEACHERS FACTORS INFLUENCING STUDENTS' ACADEMIC ACHIEVEMENT IN SECONDARY SCHOOLS IN NYANDARUA COUNTRY, KENYA.

Klaus, D. (2016). Learner attrition in an advance vocational online training. *Photonics*, 1-9.

Kraak, J., Paterson, A., & Boka, K. (2016). *Change Management in TVET Colleges: Lessons learnt from the field of practice.* Cape Town: African Minds.

Kudlas, J. (1994). Implications of OBE: What Should You Know About Outcome-based Education? *Science Teacher*.

LeCompte, M. (2000). Analysing qualitative data. *Theory into practice, 39(2)*, 146-154.

Lestari, N., & Juniati, D. (2018). Exploring the knowledge of content and teaching (KCT) of prospective maths teachers in planning mathematical literacy teaching. *Journal of Physics: Conference series 1097(1) p.012150 IOP Publishinh*.

Liehr, P., & Smith, M. (1999). Middle range theory:Spinning research and practice to create knowledge for the nw millennium. *Advance in Nursing Science,12(4) 81-91*.

Lincoln, Y., & Guba, E. (1985). *Naturalistic inquiry.* Newbury Park CA: Sage Publication.

Liu, y., & Hong, H. (2009). Regulative discourse in Singapore Primary English Classroom: teachers choice of directive. *Language and Education23(1)*, 1-13.

Machaba, F. (2017). Pedagogical Demands in Mathematics and Mathematical Literacy : A Case of Mathematics and Mathematical Literacy Teachers and Facilitators. *Eurasia Journal of Mathematics, science and Technology Education 14(1)*, 95-108.

Mahlabela, P., mahlobo, N., & Ndab, T. (2018). ARE WE WINNING THE BATTLE AGAINTS POOR PERFORMANCE IN MATHEMATICS? *Mathematics Education of South Africa*, 1-13.

Makeleni, N., & Sethusha, M. (2014). The experiences of Foundation Phase Teachers in Implementing the Curriculum. *Meditarranean Journal of Social Science 5(2)*.

Makonye, J., & Fakude. (2016). A Study of Errors and Misconceptions in the Learning of Addition and Subtraction of Direct Numbers. *SAGE Open 6(2)*.

Makumane, M., & Khoza, S. (2018). "Educators' reasoning and their effects on successful attainment of curriculum goals. *South African Journal of Higher Education, 34(2)*, 11-95.

Makumane, M., & Khoza, S. (2020). Educators' reasoning(s) and their effects on successful attainment of curriculum goals. *South African Journal of Higher Education 34(2)*, 95-111.

Maphalala, M., & Mpofu, N. (2018). Embedding values in South African curriculum: by design or default? *South African Journal of Education,38(3)*, 1-11.

Maphalala, N., Khumalo, N., & Khumalo, N. (2021). Student teachers' experience of the emergency transition to online learning during the COVID-19 loxkdown at a South African University. *Perspective in Education 39(3)*, 30-43.

Maree, K. (2007). *First Steps in Research.* Pretoria: Van Schaik Publishers.

Marsh, C. (2009). *Key Concepts for understanding curriculum (3rd ed).* London: Routledge.

MArshall, C., & Rossman, G. (2010). *Designing Qualitative Research (5th ed) .* Thousand Oaks: CA: Sage Publications.

McBride, T., Papier, J., & Needham, S. (2009). Technical Vocational Education Training(TVET) College Lecturers in the Wersten Cape. *University of Wersten Agricultural Institute. Further Educatin and Training(Technical Vocational Education Training(TVETI))*.

McGregor, S. (2008). Ideological maps of consumer education. *International Journal of Consumer Studies*, 437-447.

McGuirk, P., & O'Neill, P. (2016). Using questionnaires in qualitative human geography.

Merriam, S. (1988). *Case Study in Education: A qualitative research approach.* San Fransisco: Jossey-Bass.

Mhlanga, D., & Moloi, T. (2020). COVID-19 and the digital transformation of education: What are we learning on 4IR in South Africa. *Education science, 10(7)*, 180.

Mills, J., & Treagust, D. (2003). Engineering education-Is problem-based or project-based learning the answer. *Australasian journal of engineering education,3(2)*, 2-16.

Mofokeng, K. (2018). ENHANCING TEACHING OG MATHEMATICAL LINEAR PROGRAMMING USING THE REALISTIC MATHEMATICS EDUCATION APPROACH AT TVET COLLEGES. *Proceedings of the 24th Annual National Congress of the Association for Mathematics Education of South Africa*.

Molapo, L., Stears, M., & Dempster, E. (2012). Interpretation and Implementation of the environmental education curriculum: A case study of three Lesotho schools. *ACta Academica 44.4*, 202-229.

Molapo, M., & Pillay, V. (2018). Politicising curriculum implementation: Th case of primary schools. *South African journal of education,38(1)*.

Motala, S., & Menon, K. (2020). In search of the 'new normal' Reflection on teaching and learning during COVID-19 in a South African university . *South African Review of Education with Education with Production 26(1)*, 80-89.

Motaung, L., & Dube, B. (2020). WhatsApp Messenger as a Mediation Tool in times of COVID-19 for Enhancing Student Engagement in e-tutorials at Rural South African University. *Journal of Social Research10(6)*, 214-224.

Mpondomse, S. (2016). The Power of Partnership. *Independent Thinking*, 1-16.

Mpungose, C. (2020). Beyond limits: Lecturers' reflections on Moodle uptake in South African University. *Education and Information Technologies, 2020(4),* , 1-20.

Mpungose, C. (2020). Is Moodle or WhatsApp the preferred e-learning platform at a South University,First Year Students' Experience. *Education and Information Technologies, 25(2)*, 927-941.

Mthethwa, T. (2013). Exploring teachers' interpretations and implementations of the intended mathematical literacy curriculum. *Doctoral dissertation*.

Mthethwa, T. (2019). Mathematical Literacy,Mathematics in Context: Whose Context is this for? *ASSOCIATION FOR MATHEMATICS EDUCATION OF SOUTH AFRICA*, 214.

Ndlandla, S. (2017). Examining primary school teachers' understanding of teaching geometry through the problem solving approach in Swaziland. *Doctoral dissertation*.

Ndlovu, N. (2018). Managing continuing professional development of lecturers in Mpumalanga technical and vocational education and training college. *Doctoral dissertation*.

Ndwandwe, S., & Dlamini, B. (2013). Curriculum Reforms and Competence Level of High School Agriculture Teachers in Swaziland. *Journal of International Agricultural Extension Education 20(3)*, 33-44.

Nehls, K., Smith, B. D., & Schneider, H. A. (2015). Video-Conferencing Interviews in Qualitative In Hai-Jew, S. (Ed.). Enhancing Qualitative and Mixed Methods Research with Technology. *U.S.A.: Information Science Reference (IGI Global).* , 140-157.

Ngoveni, M. (2018). Factors linked to poor perfomance for National Certificate (vocational) L2 mathematics students. *Master of Education (Thesis)*, 71-73.

Ngulube, P. (2015). Qualtitative data analysis and interpretation: Systematic search for meaning: Addressing research challenges: Making headway for developing researchers. 131-156.

Ngxola, N. (2013). Teaching evolution in a new curriculum: Life Science teachers' concerns and needs. *Doctoral dissertation*.

Noto, M., Pamuditya, S., & Handayani, V. (2020). Exploration of Learning Obstacle Based on Mathematical Undestanding of Algebra in Junior High School. *Eduma: Mathematics Education Learning and Teaching 9(1)*, 14-20.

Nowell, L., Norris, J., White, D., & Moule, N. (2017). Thematic analysis: Striving to meet the trustworthiness criteria. *International Journal of Qualitative Method*.

Nzimande, C. (2019). Lecturers' Reflections on the Teaching of Electrical Systems and Construction NQF L4 NCV Curriculum at TVET College Campuses in KwaZulu-Natal. *Master of Education Curriculum Studies*, 95.

Online teaching and learning the students' eye-uncertainty through the COVID-19 lockdown: A qualitative case study in Gauteng Province, South Africa. (2021). *Radiography*, 193-198.

Ornek, F. (2008). A overview of a theoritical framework of phenomenography in qualitative education research: A example from physics education research. *Asia-Pacific Forum on Science Learning and Teaching 9(2)*.

Papier, J. (2009). Getting the Right Learners into the Right Programmes: An investigation into Factors That Contributed to the Poor Performance of FET Colleges Learners NCV2 and NCV3 Programmes in 2007 &2008 - Reasons and Recommendations . *Cape Town: FET Institute*.

Parker, D. (2006). Grade 10-12 Mathematics curriculum reform in South Africa: Atextual analysis of new national curriculum statements. *African Journal of Research in Mathematics, Science and Technology Education*.

Patton, M. (1990). *Qualitative evaluation and research mehods (2nd ed).* Newbury Park: CA SAGE.

Paul, A. (2019). Exploring lecturers' experiences of teaching level 2 Life Orientation (Computer Skills) in National Certificate Vocational at a TVET College in a Township. *Doctoral dissertation*.

Phaeton, M., & Stears, M. (2016). Exploring the Alignments of the Intended and Implemented Curriculum Through Teacher Interpretation: A Case Study of A-Level Biology Practical Work. *Eurasia Journal of Mathematics, Science and Technology Education*, 13(3).

Pillay, A., & Ngcobo, S. (2010). Source of stress and support among rural university students. *SAGE*, 5.

Pirtheepal, T. (2019). Exploring teachers' experiences of implementing an integrated natural science and technology curriculum in the intermediate phase. *Doctoral dessertation*.

Powell, L. (2014). Reimagining the purpose of vocational education and training. *Unpublished PhD Thesis,University of Nottingham*.

Powell, L., & McGrath, S. (2014). Exploring the Value of the Capability Approach for Vocational Education and TrainingEvaluation: Reflections from South Afric. *In Education,Learning,Training*, 126-148.

Remillard, J. (2005). Examining key concepts in research on teachers' use of mathematics curricular. *Review of Educational Research 75(1)*, 211-246.

Rienks, J., & Taylor, S. (2009). *Attrition and academic perfomance of students identified as at risk using administrative data alone.* Australia: University of Tasmania.

Rowley, J., & Slack, F. (2004). Conducting a literature review. *Management research news*.

RSA. (2012). *Document for discussion: Challenges facing FET College subsystem, FET Round Table towards finding resolutions in partneship with stakeholders.* Pretoria: Government Printer.

RSA. (2013). Policy on professional qualifications for lecturers in technical and vocational education and training. *Government Gazette,36554:2(Notice 410); 11 June 2013*.

RSA. (2016). *South African Qualification Authority (SAQA): SAQA Bulletin.* Pretoria: SAQA.

Seah, W., Andersson, A., Bishop, A., & Clarkson, P. (2016). What would the mathematics curriculum look like if values were the focus? *For the learning of mathematics*, 14-20.

Selling, S. (2016). Making Mathematical Practices Explicit in Urban Middle and High School Mathematics Classroom. *Journal for Research in Mathematics Education47(5)*, 505-551.

Shakizah, W. (2016). Students attrition in the TVET College institutions. *Asian Social Science*, 1-14.

Shenton, A. (2004). Stratergies for ensuring trustworthiness in qualitative research projects. *Education for information 22(2)*, 63-75.

Shulman, L. (1986). Those who understand knowledge growth in teaching. *Educational research 15(2)*, 4-14.

Singh, P. (2002). Pedagogical knowledge: Bernstein theory of the pedagogical device. *British journal of sociology of education 23(4)*, 571-582.

Smith, B., & McGannon, K. (2018). Developing rigor in qualitative research: Problems and opportinities with support and exercise psychology. *International review of support and exercise psychology, 11(1)*, 101-121.

Smith, E., & Grace, L. (2011). Vocational educators' qualifications: A pedagogical poor realisation? *International Journal of Training Research 9(3):204-217*, 204-217.

Smith, L. .., & Southerland, S. (2007). Reforming practice or modifying reforms? Elementary teachers' response to the tools of reform. *Journal of Research in Science Teaching,44(3)*, 396-423.

Sokhulu, L. (2020). Students’ experiences of using digital technologies to address their personal research needs during COVID-19 lockdown. *African Identities 19(4)*, 436-452.

Spiggle, S. (1994). Analysis and Interpretation of Qualitative Data in Consumer Research. *Journal for consumer research 21(3)*, 491-503.

Statistics, S. A. (2018). *Quartely labour Force Survey.* Pretoria: Government Printers.

StatisticsSolution. (2019). *What is the credibility in qualitative research and how do we establish it?* Retrieved January 24, 2021, from http://www.statisticssolution.com

Tamarat, W., & Teferra, D. (2020). COVID-19 poses a serious threat to higher education . *University World News*.

Tapp, J. (2015). Framing the curriculum for participation: a Bernsteinian perspective on academic literacies. *Teaching in higher education*, 20(7),711-722.

Terblanche, T., & Bitzer, E. (2018). Leading curriculum change in South African technical and vocational education and training. *Journal of Vocational, Adult and Continuing Education and Training 1(1)*, 104-104.

Times(DHET), T. C. (2019). TVET College Times. *The official Quartely TVET College Newsletter and Journal(58)*, 3.

Timperly, H., Wilson, A., Barrar, H., & Fung, I. (2008). Teacher professinal learning and development: Best evidence synthesis iteration. *Willington: Ministry of Education Retrived from http://www.minedu.govt.nz/goto/bestevidencesynhesis*.

Tshabalala.T, & Ncube, A. (2016). Cause of poor perfomance of ordinary level pupilsin mathematics in rural secondary in Nkayi district: Learner's attricutions. *Nova Journal of Medical and Biological Science,1(1)*.

Umigiraneza, Bansilal, & North. (2018). Exploring teachers' descriptions of 'ways of working with the curriculum' in teaching Mathematics. *South African Journal of Education* .

Van de Walle, J., KArp, K., & Bay-Williams, J. (2016). *Elementary and middle school mathematics.* UK: Pearson Education.

Van den Akker, J. (2003). The Science Curriculum:between ideals and outcome. *International Handbook of Science Education*, 421-447.

Van Den Akker, J., de Boer, W., Folmer, E., Kuiper, W., Letschert, N., Nieveen, N., & Thijis, A. (2009). *Curriculum in development.* Enschede: Netherlands Institute for Curriculum Development.

Van der Bijl, A., & Lawrence, M. (2019). Retention and attrition among National Certificate (Vocational) civil and construction students in South African TVET. *Industry and Higher Education,32(2)*, 127-134.

Van Manen, M. (1995). On the epistemology of reflective practice. *Teachers and Teaching: Theory and Practice1(1)*, 33-50.

Venkatakrishnan, H., & Graven, M. (2006). Mathematical Literacy in South Africa and Functional Matthematics in England: A consideration of overlaps and contrast. *Pythagoras Journal*, 14-28.

Wadekind, V. (2008). *Report on the research on further education and training (FET) colleges in South Africa.* Pietermaritzburg, South Africa: University of Kwazulu-Natal.

Walford, G. (2005). 'Research Ethical Guidelines and Anonymity'. *International Journal of cademic Ethics 1(2)*, 83-93.

Walker, C. (1998). Learning to learn phenomenography and children learning. *Educational and Child Psychology*, 15, 25-33.

Wessels, H. (2008). Statistics in the South African Schools Curriculum: Content, assessment and teacher training. *In proceedings of the 18th ICMI Study Conference and 2008 IASE Round Table Conference 1(30)*.

Wiersma, W. (2002). Research methods in education. *An introduction, 7th ed,Boston; Allyn and Bacon*.

Williams, C. (2007). Research Methods. *Journal of Business Economic Research*, 67-68.

Yazan, B. (2015). Three approaches to case study methods in education:Yin,Merriam,and Stake. *The qualitative report,20(2),134-152*.

Zinn, B., Raisch, K., & Reimann, J. (2019). Analysing training needs of TVET teachers in South Africa. An emperical study. *International Journal Of Research in Vocational Education and Training 6(2)*, 174-197.

zuga, K. (1994). *Implementing technology education: Areview and synthesis of the research literature:.* Columbus: OH: Center on Education and Training for Employment.

Zulu, W. (2018). Students attrition in TVET Colleges: A case study of Elangeni TVET College in South Africa. *Masters in Public Administration UKZN*, 96-104.

Appendix 1: Ethical clearance

31 July 2020

Miss Lungile Ngidi (200306336)
School Of Education
Edgewood Campus

Dear Miss Ngidi,

Protocol reference number: HSSREC/00001677/2020
Project title: Exploring lecturers' interpretation and implementation of the intended NCV Mathematics curriculum at a TVET College in KwaZulu Natal Durban
Degree: Masters

Approval Notification – Expedited Application

This letter serves to notify you that your application received on 20 July 2020 in connection with the above, was reviewed by the Humanities and Social Sciences Research Ethics Committee (HSSREC) and the protocol has been granted **FULL APPROVAL**

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

This approval is valid until 31 July 2021.
To ensure uninterrupted approval of this study beyond the approval expiry date, a progress report must be submitted to the Research Office on the appropriate form 2 - 3 months before the expiry date. A close-out report to be submitted when study is finished.

All research conducted during the COVID-19 period must adhere to the national and UKZN guidelines.

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

Yours sincerely,

[redacted]

Professor Dipane Hlalele (Chair)

/dd

Humanities & Social Sciences Research Ethics Committee
UKZN Research Ethics Office Westville Campus, Govan Mbeki Building
Postal Address Private Bag X54001, Durban 4000
Tel +27 31 260 8350 / 4557 / 3587
Website http://research.ukzn.ac.za/Research-Ethics/

Appendix 2: Application to conduct a research at a college

Ngidi L (Ms)
Box 91
KwaDabeka
3612

Dear Sir/ Madam
08 July 2020

APPLICATION FOR THE PERMISSION TO CONDUCT RESEARCH IN YOUR COLLEGE

I am Lungile Ngidi a lecturer at Elangeni TVET College KwaDabeka Campus, currently studying for Masters in Education (Mathematics Education) at the University of KwaZulu-Natal (Edgewood Campus), Pinetown South Africa.
I am conducting a study titled: **Exploring lecturers' interpretation and implementation of the intended NCV Mathematics curriculum at a TVET College in Kwa-Zulu Natal Durban.** I hereby request permission to conduct this study with your college lecturers .
Please note the following:

- The college and lectures' confidentiality are guaranteed.
- Due to COVID 19 pandemic interviews will be held online via Zoom meeting approximately 30-45 minutes after college hours.
- Any information given by your college lecturers cannot be used against the college, and the collected data will only be used for the purposes of this research.
- There will be no incentive or benefit for participation in this project.
- Data will be stored in a coded computer and shredded after 5 years.
- Participating in this research project is entirely voluntary; participants are free to withdraw at any point if they wish to do so.
- College and lecturers' involvement are purely for academic purposes only, and there is no financial benefit involved

Yours faithfully
Lungile Ngidi
LNGIDI@WEBMAIL.CO.ZA
076 972 7260

My supervisor is Dr TM Mthethwa who is a Discipline head & lecture: Mathematics education, school of education, Edgewood Campus, University of KwaZulu-Natal, (Tel): 031 260 2634. (Cell): 082 631 0695, Email: MthethwaT@ukzn.ac.za

You may also contact the research office: (HSSREC)
Tel: 031 260 3587, Email: hssrec@ukzn.ac.za

Thank you in advance for your contribution in this research project.

Declaration

I .....(Full names) hereby confirm that I understand the content of this document and the nature of the research project, and I consent for the college and lecturers to participate in the research project.

I understand that the college and lecturers are at liberty to withdraw from the project at any time, should they so desire.

_____ _____

Signature Date

Stamp

Appendix 3: Approval letter from the college principal

higher education & training
Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

Elangeni College
Technical and Vocational Education and Training

An ISO 9001 and OSHAS 18001 certified organisation.

14 July 2020

Dear Ms L Ngidi

RE: REQUEST FOR USING COLLEGE AS SITE OF RESEARCH

Your communication dated 08 July 2020 refers:

Elangeni TVET College has no objection to you using our campuses as sites of research for *"Exploring lecturers' interpretation and implementation of the intended NCV Mathematics curriculum at a TVET College in KwaZulu-Natal Durban."*

However, the following conditions for external research apply:

The college will have the right to approve content with regard to research instruments and research analysis.

- The relevant documents must be forwarded to the Rector and approval of usage will be given by the Rector in writing
- The name of the college or any of its sites cannot be used in any documents.
- The name/s of staff employed by the college cannot be used.
- The use of any findings that reflect negatively on the College, its partners or any related body must be approved in writing by the Rector.

Please note that failure to comply with all of the above conditions will result in the necessary legal action being taken against you.

Your cooperation in this regard will be highly appreciated

Yours sincerely

[redacted]

T.J Aryetey
Principal

I have read the contents of this letter and I accept the conditions

NAME _____ SIGNATURE _____ DATE _____

SABS ISO 9001 Central Office. 15 Portsmouth Road, Pinetown, 3610 Postal Address. Private Bag X9032, Pinetown, 3600 SABS OHSAS 18001
Email: info.elangeni@elangeni.edu.za Phone. 031 716 6700 Fax. 031 716 6777
INANDA 131 of Street 1088/2 Inanda Tel:031 519 0933
KWADABEKA 140 Khululeka Road Clermont Tel:031 71 0313
KWAHASHU F 5 Mandela Road KwaMashu Tel:031 503 9708
MPUMALANGA 280 Shesi Main Road Mpumelanga Tel 031 771 0148/2568
NDWEDWE P100 Main Road Ndwedwe Tel:074 582 9178
NTUZUMA G 394 Bhendidle Drive Ntuzuma Tel:031 509 1924
PINETOWN 33 Banabo Lane Pinetown Tel:031 702 3260
QADI Zulu Reserve Road Botha's Hill Tel:031 777 1742

Appendix 4: Consent letter for participants

UNIVERSITY OF KWAZULU-NATAL
INYUVESI YAKWAZULU-NATALI

UKZN HUMANITIES AND SOCIAL SCIENCES RESEARCH ETHICS COMMITTEE (HSSREC)

APPLICATION FOR ETHICS APPROVAL
For research with human participants

INFORMED CONSENT RESOURCE TEMPLATE

Information Sheet and Consent to Participate in Research

Date: 08 July 2020

Dear Sir/Madam

My name is Lungile Ngidi from Elangeni TVET College. I am a student in the College of Humanities and Social Sciences, at University of Kwa-Zulu Natal studying towards a Master degree (Specializing in Mathematics Education). My contact number is 076 972 7260 and my email address is: lngidi@webmail.co.za

You are being invited to consider participating in a study titled: ***Exploring lecturers' interpretation and implementation of NCV Mathematics curriculum at a TVET College in Kwa-Zulu Natal Durban***

The aim of this study is to explore how do NCV Mathematics lecturers interpret and implement the NCV Mathematics curriculum.

Due to COVID 19 pandemic the study will involve the following procedure, the online semi-structured interviews via Zoom meeting. The duration of each interview is estimated to last about thirty to forty-five (30-45) minutes. This is a self-funded study and is conducted solely for academic/ educational purposes.

Please note that:

- Your confidentiality is guaranteed as your inputs will not be attributed to you in person but, reported only as a population member opinion.
- Any information given by you cannot be used against you, and the collected data will be used for the purpose of this research only
- There will be no limit or any benefit that the participants may receive as part of their participation in this research project.
- Data will be stored in a secure storage and destroyed after five years.
- You have a choice to participate and not to participate or stop to participate at any given time. You will not be penalized for taking such an action.
- The participants are free to withdrawn from the research anytime without any negative or undesirable consequence to themselves.
- Real names of the participants will not be used, but pseudonyms (false names).
- Your involvement is purely for academic purpose only, and there are no financial benefit involved

This study has been ethically reviewed and approved by the UKZN Humanities and Social Sciences Research Ethics Committee (approval number_____).

In the event of any problems or concerns/questions you may contact the researcher at 076 972 7260 the UKZN Humanities & Social Sciences Research Ethics Committee, contact details as follows:

HUMANITIES & SOCIAL SCIENCES RESEARCH ETHICS ADMINISTRATION

Research Office, Westville Campus

Govan Mbeki Building

Private Bag X 54001

Durban

4000

KwaZulu-Natal, SOUTH AFRICA

Tel: 27 31 2604557- Fax: 27 31 2604609

Email: HSSREC@ukzn.ac.za

You may also feel free to contact my supervisor using the following details:

Dr TM Mthethwa

Tel: 031 260 2634

MthethwaT@ukzn.ac.za

CONSENT

I _____.

have been informed about the study titled: : ***Exploring lecturers' interpretation and implementation of NCV Mathematics curriculum at a TVET College in Kwa-Zulu Natal Durban***

I understand the purpose and procedures of the study.

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

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

I have been informed about the unavailability of compensation or medical treatment if injury occurs to me as a result of study-related procedures.

If I have any further questions/concerns or queries related to the study, I understand that I may contact Dr TM Mthethwa on 031 260 2634

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

HUMANITIES & SOCIAL SCIENCES RESEARCH ETHICS ADMINISTRATION

Research Office, Westville Campus

Govan Mbeki Building

Private Bag X 54001

Durban

4000

KwaZulu-Natal, SOUTH AFRICA

Tel: 27 31 2604557 - Fax: 27 31 2604609

Email: HSSREC@ukzn.ac.za

Additional consent, where applicable

I hereby provide consent to:

Audio-record my interview YES / NO

Allow the researcher to observe my lecturing lessons.

YES/NO

_____ _____

Signature of Participant **Date**

_____ _____

Signature of Witness **Date**

(Where applicable)

_____ _____

Signature of Translator **Date**

(Where applicable)

Appendix 5: Interview protocol

Exploring lecturers' interpretation and implementation of the intended NCV mathematics curriculum at a TVET college in KwaZulu Natal Durban

Researcher: Lungile Ngidi

Student Number: 200306336

INTERVIEW PROTOCOL

date: 03/ 09/2020 time:10 AM

interview duration:30-45 minutes

interview method: Semi-structured interview

Research question

How do lecturers interpret and implement NCV Mathematics curriculum?

Sub-questions

(a) What is your understanding of the NCV Mathematics curriculum?

Probe: What is it?

(b) How do you view the purpose, nature, and scope of NCV Mathematics curriculum?

(c) How do you find the teaching NCV Mathematics, what are the challenges that you encounter in teaching NCV Mathematics?

(d) How do you deal with the challenges that you have identified?

(e) What would you change or add to the current NCV Mathematics curriculum?

Appendix 6: Editing certificate

GENEVIEVE WOOD
P.O. BOX 511 WITS 2050 | +525562308808

EDITING CERTIFICATE
LANGUAGE EDITING SERVICES

Date: 2022/8/30

This serves to confirm that the document entitled:

Exploring lecturers' interpretation and implementation of the intended NCV mathematics curriculum at a TVET college in KwaZulu Natal Durban

By
Lungile Ngidi

has been reedited on behalf of its author, with unclear aspects of language noted for the author's revision, and with inconsistent referencing flagged.
The editor takes no responsibility for the final state of the document in this regard.

Genevieve Wood
PhD candidate
Wits University

Appendix 7: Turnitin report

Turnitin Originality Report

Processed on: 10-Jan-2022 8:22 AM CAT
ID: 1686462946
Word Count: 21120
Submitted: 7

Exploring Lecturers' Interpretation and Implementation of the Mathematics curriculum at a TVET College By Lungile Ngidi

Similarity Index	Similarity by Source	
7%	Internet Sources:	7%
	Publications:	2%
	Student Papers:	1%

1% match ()
Mthethwa, Themba M. "Exploring teachers' interpretations and implementations of the intended mathematical literacy curriculum", 2014

1% match (Internet from 16-Jul-2021)
https://Www.ejmste.com/download/pedagogical-demands-in-mathematics-and-mathematical-literacy-a-case-of-mathematics-and-mathematical-5244.pdf

< 1% match ()
Umuqiraneza, Odette.. "Exploring teachers' instructional practices, confidence and beliefs in teaching mathematics and statistics.", 2018

< 1% match ()
Nzimande, Cornelius Hlangene.. "Lecturers' reflections on the teaching of electrical systems and construction NQF L4 NCV curriculum at TVET college campuses in KwaZulu-Natal.", 2019

< 1% match ()
Pirtheepal, Tashmika.. "Exploring teachers' experiences of implementing an integrated natural science and technology curriculum in the intermediate phase.", 2019

< 1% match ()
Nkohla, Msimelelo Buyisile.. "Educators' reflections on their practices of Agricultural Sciences curriculum and Assessment Policy statement.", 2016

< 1% match ()
Zulu, Wiseman Vuyani.. "Students attrition in TVET colleges : a case study of Elangeni TVET College in South Africa.", 2018

< 1% match (Internet from 26-Aug-2021)
https://researchspace.ukzn.ac.za/bitstream/handle/10413/15423/Subramoney_Preshaan_2016.pdf

< 1% match (Internet from 19-Aug-2019)
https://researchspace.ukzn.ac.za/xmlui/bitstream/handle/10413/13753/Mc_Knight_Marcell_2015.pdf?isAllowed=y&sequence=1

< 1% match (Internet from 26-Aug-2021)
https://researchspace.ukzn.ac.za/jspui/bitstream/10413/17245/1/Ntombela_Gladys_Nokwazi_Nyameka_2019.pdf

< 1% match (Internet from 18-Jul-2020)
http://researchspace.ukzn.ac.za/bitstream/handle/10413/11478/Duma_Alfred_Lucky_2014.pdf?isAllowed=y&sequence=1

< 1% match ()
Parker, Diane Cecile. "The specialisation of pedagogic identities in initial mathematics teacher education in post-apartheid South Africa", 2009

< 1% match ()
Lutaaya, Jackson.. "Exploring the views of TVET lecturers on the implementation of the NCV curriculum.", 2017

< 1% match ()
Buthelezi, Zanele Gladness.. "At the policy-practice interface : exploring technical vocational education and training lecturers' educational reform experiences.", 2016

< 1% match ()
Kayser, Avril Freda Francina. "The lived experiences of intermediate phase teachers of curriculum renewal processes from 1998 to 2012 in Port Elizabeth", Faculty of Education, 2013

< 1% match ()
Mosholi, Thandeka Judith. "The impact of the introduction of the new FET system at colleges in the Free State with special reference to Motheo FET College", Bloemfontein : Central University of Technology, Free State, 2006

< 1% match (Internet from 30-Jun-2021)
https://www.tandfonline.com/doi/full/10.1080/00220272.2018.1488998

< 1% match (Internet from 01-Nov-2020)
https://www.tandfonline.com/doi/full/10.1080/13636820.2018.1437062

< 1% match (Internet from 07-Jun-2020)
https://www.tandfonline.com/doi/pdf/10.1080/10288457.2006.10740605

< 1% match (Internet from 05-Jun-2020)
http://www.dhet.gov.za/National%20Certificates%20NQF%20Level%204/NC(Vocational)%20Subject%20Guidelines%20Level%204/Fun

< 1% match (Internet from 03-Feb-2021)
https://www.dhet.gov.za/National%20Certificates%20NQF%20Level%204/NC(Vocational)%20Assessment%20Guidelines%20Level%204

< 1% match (Internet from 20-May-2016)
http://www.dhet.gov.za/National%20Certificates%20NQF%20Level%203/NC(Vocational)%20Assessment%20Guidelines%20Level%203/

< 1% match (Internet from 21-Jan-2020)