EXPLORING AND IMPROVING CURRICULUM IMPLEMENTATION THROUGH CONTINUING PROFESSIONAL DEVELOPMENT PROGRAMMES OF GRADE 10 SCIENCE TEACHERS: A MULTIPLE CASE STUDY

BY

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DECLARATION

I, **OBILANA ADEREMI ADESOJI**, declare that **EXPLORING AND IMPROVING CURRICULUM DELIVERY THROUGH CONTINUING PROFESSIONAL DEVELOPMENT PROGRAMMES OF GRADE 10 SCIENCE TEACHERS: A CASE STUDY** is my own original work, and that all the sources that I have used or quoted have been indicated and acknowledged by means of complete references. I further declare that I have not previously submitted this work, or part of it, for examination at UNISA for another qualification or at any other higher education institution.

OBILANA ADEREMI ADESOJI

26 May 2023

…….. ……

SIGNATURE **DATE**

DECLARATION BY SUPERVISOR

I, Professor E.C. du Plessis, declare that the thesis has been submitted to originality checking software.

26 May 2023

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DEDICATION

This thesis is dedicated to the Almighty God, the Beginning and the End, the Alpha and Omega. You are worthy to be praised!

Furthermore, it is dedicated in the memory of my late father, Alhaji (Chief) Adesegun Obilana, may his soul rest in peace.

ABSTRACT

Implementing an effective curriculum is expected by all science teachers since they are the curriculum implementers. However, it was revealed that many of these teachers, especially in rural areas, struggle to implement and deliver the curriculum effectively. The teachers mentioned challenges hampering them to deliver the curriculum effectively.

This study was therefore conducted to explore and establish the challenges facing Grade 10 science teachers to deliver an effective curriculum and to further elucidate on the nature of Continuing Professional Development (CPD) programmes as a necessary intervention to assist them in improving their curriculum delivery.

Data were collected from Grade 10 science teachers teaching Life Sciences in 12 secondary schools through two different sources, which were semi-structured interviews and lesson presentation observations. The data were collected before and after a CPD programme interventional workshop, which was organised by me for the participants (i.e., pre-interviews, pre-lesson observations and post-interviews, post-lesson observations).

The study's findings revealed the curriculum challenges facing science teachers in delivering an effective and proficient curriculum. It was also discovered that the teachers seriously needed professional support. Above all, the research findings showed the nature and design of a CPD programme that is relevant, and which addressed the curriculum challenges of the science teachers by improving their curriculum delivery.

The results of this study were used to propose a model which could be used to address the curriculum challenges of science teachers and to improve their curriculum delivery.

Key words: Continuing professional development, curriculum changes, curriculum challenges, curriculum implementation, interventional workshop, science teachers, specialisation, qualification.

DIE VERKENNING EN VERBETERING VAN KURRIKULUM-IMPLEMENTERING DEUR MIDDEL VAN PROGRAMME VIR VOORTGESETTE PROFESSIONELE ONTWIKKELING VIR GRAAD 10-WETENSKAPONDERWYSERS: ’n VEELVULDIGEGEVAL-STUDIE

OPSOMMING

Die doeltreffende implementering van die kurrikulum word van alle wetenskaponderwysers verwag aangesien hulle die persone is wat aan die kurrikulum uitvoering gee. Daar is egter bevind dat heelwat van hierdie onderwysers, veral in landelike gebiede, probleme ondervind om die kurrikulum doeltreffend te implementeer en aan te bied. Die onderwysers het uitdagings wat die doeltreffende implementering van die kurrikulum belemmer, uitgewys.

Hierdie studie is derhalwe gedoen met die doel om die uitdagings rakende die doeltreffende implementering van die kurrikulum waarmee graad 10-wetenskaponderwysers gekonfronteer word, te verken en te identifiseer en om die aard van programme vir voortgesette professionele ontwikkeling (VPO) as ’n nodige ingryping vir die verbetering van hulle aanbieding van die kurrikulum te belig.

Twee verskillende metodes, naamlik semigestruktureerde onderhoude en leswaarneming, is gebruik om data van graad 10-wetenskaponderwysers wat Lewenswetenskappe in 12 sekondêre skole gee, in te samel. Data is voor en ná ’n VPO-program-ingrypingswerkswinkel wat die navorser vir die deelnemers gereël het (dit wil sê, pre-onderhoude, preleswaarneming en postonderhoude, postleswaarneming), ingesamel.

Die bevindings van die studie het die uitdagings rakende die doeltreffende en bedrewe aanbieding van die kurrikulum wat wetenskaponderwysers ondervind, aan die lig gebring. Daar is voorts bevind dat onderwysers dringend professionele bystand benodig. Die navorsingsbevindings het bowenal op die aard en die ontwerp van ’n VPO-program wat relevant is en wat die wetenskaponderwysers kan help om kurrikulumverwante uitdagings te bowe te kom en hulle aanbieding van die kurrikulum kan verbeter, gedui.

Die resultate van hierdie studie is gebruik om ’n model te ontwikkel wat gebruik kan word om die kurrikulum-uitdagings wat wetenskaponderwysers ondervind, te bowe te kom en hulle aanbieding van die kurrikulum te verbeter.

Kernbegrippe: Voortgesette professionele ontwikkeling, kurrikulum-veranderinge, kurrikulum-uitdagings, kurrikulum-implementering, ingrypingswerkswinkel, wetenskaponderwysers, spesialisasie, kwalifikasie.

GO NYAKIŠIŠA LE GO KAONAFATŠA PHETHAGATŠO YA LENANEOTHUTO KA MANANEO A TLHABOLLO A SEPROFEŠENALE AO A TŠWELAGOPELE A BARUTIŠI BA THUTO YA MAHLALE YA KREITI YA 10: DIKHEISESTATI TŠE NTŠI

KAKARETŠO

Go phethagatša lenaneothuto gabotse go letetšwe ke barutiši ka moka ba thuto ya mahlale ka ge e le bona baphethagatši ba lenaneothuto. Le ge go le bjalo, go utolotšwe gore bontši bja barutiši ba, kudukudu dinagamagaeng, ba katana le go phethagatša le go aba lenaneothuto ka bokgoni. Barutiši ba boletše ka ditlhohlo tšeo di ba šitišago go aba lenaneothuto gabotse.

Ka fao nyakišišo ye e diretšwe go nyakišiša le go hwetša ditlhohlo tšeo barutiši ba thuto ya mahlale ba Kreiti ya 10 ba lebanago le tšona ge ba aba lenaneothuto gabotse le go hlaloša gape mohuta wa mananeo a Tlhabollo ya Profešenale ye e Tšwelago Pele (CPD) bjalo ka kgato ya maleba go ba thuša go kaonafatša kabo ya bona ya lenaneothuto.

Datha e kgobokeditšwe go tšwa go barutiši ba thuto ya mahlale ba Kreiti ya 10 bao ba rutago Thuto ya Mahlale a Bophelo dikolong tše 12 tša magareng ka methopo ye mebedi ye e fapanego, yeo e bego e le dipoledišano tše di rulagantšwego seripa le ditlhokomelo tša tlhagišo ya dithuto. Datha e kgobokeditšwe pele le ka morago ga tlhahlo ya tsenogare ya lenaneo la CPD, yeo ke e rulagantšeditšego bakgathatema (e lego, dipoledišano tša pele ga nako, ditlhokomelo tša pele ga thuto le dipoledišano tša ka morago, ditlhokomelo tša ka morago ga thuto).

Dikutullo tša nyakišišo ye di utollotše ditlhohlo tša lenaneothuto tšeo barutiši ba thuto ya mahlale ba lebanego le tšona ka go aba lenaneothuto gabotse gape ka bokgoni. Go utulotšwe gape gore barutiši ba be ba nyaka thekgo ya seprofešenale kudu. Godimo ga tšohle, dikutullo tša nyakišišo di bontšhitše mohuta le tlhamo ya lenaneo la CPD leo le lego maleba, le leo le rarolotšego ditlhohlo tša lenaneothuto la barutiši ba saense ka go kaonafatša kabo ya bona ya lenaneothuto.

Dipoelo tša nyakišišo ye di šomišitšwe go šišinya mmotlolo wo o ka šomišwago go rarolla ditlhohlo tša lenaneothuto tša barutiši ba thuto ya mahlale le go kaonafatša kabo ya bona ya kharikhulamo.

Mantšu a bohlokwa: Tlhabollo ya seprofešene ye e tšwelago pele, diphetogo tša lenaneothuto, ditlhohlo tša lenaneothuto, phethagatšo ya lenaneothuto, tlhahlo ya tsenogare, barutiši ba thuto ya mahlale, tsebo ye e kgethegileng, mangwalo a thuto.

LIST OF ABBREVIATIONS

ACE	Advanced Certificate in Education
ANC	African National Congress
B.Ed	Bachelor of Education
CAPS	Curriculum and Assessment Policy Statements
CK	Content Knowledge
COVID - 19	Coronal Virus Disease of 2019
CPD	Continuing Professional Development
CPTD	Continuing Professional Teacher Development
DHET	Department of Higher Education and Training
DoE	Department of Education
DBE	Department of Basic Education
ELRC	Education Labour Relation Council
FET	Further Education and Training
HEI	Higher Education Institution
IBS	Input-Based Solution
ICT	Information Communication and Technology
IPET	Initial Professional Education of Teachers
ISPFTED	Integrated Strategic Planning Framework for Teachers' Education and Development
IQMS	Integrated Quality Management System
LDoE	Limpopo Department of Education
LTSM	Learning and Teaching Support materials
NPDE	National Professional Diploma in Education
NPDFTED	National Policy Framework for Teachers' Education and Development

NPF	National Policy Framework
NSC	National School Certificate
NQF	National Qualification Framework
OBE	Out-Based Education
PCK	Pedagogical Content Knowledge
PD	Professional Development
PRA	Participatory Reflection and Action
RNCS	Revised National Curriculum Statement
REQV	Relative Education Qualification Value
SACE	South African Council for Educators
SAMCEQ	Southern and Eastern African Consortium for
SAQA	South African Qualification Authority
SGB	School Governing Body
SMK	Subject Matter Knowledge
SMT	School Management Team
TIMS S	Trends International mathematics and Science
UNESCO	United Nations Educational, Scientific and cultural
UNICEF	United Nations International Children's Emergency
UNISA	University of South Africa

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CHAPTER 1

ORIENTATION

1.1 INTRODUCTION

In a teaching career, teachers are expected to be well fortified with teaching skills to enhance their curriculum implementation, which is one of their core duties. However, countries such as Saudi Arabia, United States of America (USA) and Turkey experienced problems in implementing an effective curriculum at schools because of changes in their curriculum (El-Deghaidy, Mansour, Aldahmash & Alshamrani, 2014; Maharaj, Rammath, Nkosi & Mkhize, 2016). In sub-Saharan Africa, a country like Tanzania, for example, encountered challenges in curriculum implementation because of changes and the adoption of a new science curriculum (El-Deghaidy et al., 2014). Likewise, South Africa is among the countries not exempted from challenges in implementing an effective curriculum at schools. The country experienced continuous changes in the education curriculum during the post-apartheid era; this led to the formulation of new education policies aimed at addressing the shortcomings in the education and training system during the apartheid era (Adu & Ngibe, 2014). The frequent changes and reforms in the curriculum of the country's education system after the new democratic dispensation in 1994 have had several negative effects on the teachers; these include, among others, how to retrain teachers across the board (Ogunniyi & Mushayikwa, 2015). Despite the efforts by the government and education stakeholders to address the challenges unfortunately, not much progress has been achieved.

Therefore, this study is anchored by my quest to assist science teachers in improving pedagogical practices in their respective classrooms through an interventional workshop of continuing professional development (CPD) programme. My experience as a Life science teacher who assisted colleagues in an interventional workshop of organised, professional development programmes alluded to the fact that teachers face many challenges in implementing a good curriculum in their classrooms because of frequent changes and reforms in the nation's education curriculum. I was a Life science teacher in a school in the Mpumalanga Department of Education and was appointed as a Cluster

Leader for the subject in the circuit. As a Cluster Leader, my duties included organising content workshops for Life science teachers and moderating their common assessment tasks. In the meetings, I facilitated the subject content workshops wherein I advised my colleagues (teachers) on the choice of teaching methodologies and strategies they could use in their classrooms to improve in delivering an effective curriculum. In return, the teachers asked me questions where necessary and for support, especially the new appointed teachers, e. g., Fudza Lusaka bursary holders. The Fudza Lusaka bursary holders are science and mathematics teachers who studied through national government bursaries. The aim is to reduce the shortages of science and mathematics teachers in South African schools. However, it is very interesting that each time I made a follow-up visit to the teachers' classrooms for support, I noticed that many of them who previously had problems with the curriculum implementation and delivery showed some level of improvement, especially in content knowledge, classroom management, teaching strategies and methods. The content knowledge (CK) of teachers is referred to as the amount of knowledge and skills that the teachers must possess on a particular subject matter (Ntuli & Mudau, 2023). The classroom management (CM) is a term that was usually used by teachers to describe the process of ensuring that classroom lessons run smoothly despite of any disruptive behaviour by learners (Viidya, 2022), whereas teaching strategies are a collection of different methods that can be used by teachers to teach the subject matter, and these may differs from lesson to lesson while teaching methods can be described as a selection of methods used by teachers to teach the subject matte and is clear (Sinha, 2022). Nonetheless, the improvement that I noticed in the teachers indicates that CPD programmes can play important roles in improving and assisting science teachers' pedagogical content knowledge. Pedagogical content knowledge (PCK) was introduced by Lee Shulman in 1986, and it is defined as the integration of pedagogy and subject content knowledge which essentially covers "what" and "how" of teaching (Shing, Saat & Loke, 2015). However, with reference to the definition of pedagogical content knowledge, science teachers should not only be more knowledgeable about their subject, but they must also be able to teach their specific subjects clearly and effectively. Thus, for the purpose of this study, the pedagogical

content knowledge (PCK) of the science teachers is very important, therefore this study focused more on it.

As mentioned earlier that my experience as a science teacher as well as a cluster leader made me aware that teachers have challenges in coping with curriculum implementation, especially because of continuous changes in the curriculum. Furthermore, I also learnt that supporting the teachers with professional activities might assist them in leveraging their predicament.

In this vein, this study aimed to explore and establish how CPD programmes can assist and improve the curriculum implementation of Grade 10 science teachers teaching Life sciences through an interventional support workshop organised for them. Data were collected from the participants (Grade 10 science teachers teaching Life sciences) before and after the interventional workshop of the CPD programme through two different sources – interviews and lesson observations (e.g., pre- and post-lesson observations and semi-structured interviews). The participants were selected from above performing schools, average-performing schools and below-average-performing schools. Three schools were chosen as centres based on the proximity and convenience of the participants. Data were collected from each of the participants in their respective centres. For example, 'Centre A' was where three participants assembled and met and data were collected from each representing their individual performing schools. Centre 'B' was where four participants also met for the collection of data by the researcher, with each of them representing an average-performing school. Likewise, in centre 'C', I collected data from five participants who gathered at the centre, with each participant representing a below-average performing school.

This study, therefore, explored and established the challenges facing science teachers in implementing an effective curriculum and shed more light on the nature of CPD programmes as a necessary intervention to assist science teachers to improve their curriculum implementation. In addition, the results of this study were used to propose a model to address the curriculum challenges and improve the curriculum implementation of science teachers.

1.2 BACKGROUND TO THE STUDY

Many countries have complained about the changes in curricula and how these changes have impacted on their classroom teaching qualities. For example, in Saudi Arabia, science teachers experienced curriculum changes because they had to move from teacher-based into learner-based teaching models. The science teachers met some difficulties in developing strategies or skills that encourage learners to explain what they think while giving appropriate examples, such as listening and responding to others' ideas, and using appropriate language for explaining scientific phenomena. In a nutshell, science teachers lack adequate dialogic skills that allow them to interact with their learners in science-based inquiry settings (Almuntasheri, 2020). This adversely affected the curriculum delivery of science teachers to their learners. As a trained science teacher, I am convinced that teachers' competency impacts the learners' achievement positively or negatively, as they are referred to as the curriculum implementers. Therefore, any changes in the curriculum will affect the competency of the teachers if they are not supported.

Similarly, a report published by United Nations Children's Fund (United Nations International Children's Emergency Fund [UNICEF], 2018) argued that despite several efforts to reform the basic education curriculum in many countries in the Eastern and Southern Africa (ESA) region, like Namibia, Ethiopia, Malawi and Uganda, learning ratings have remained stubbornly low because of the difficulty encountered in the implementation to migrate from the traditional curriculum (generally defined as being 'academic' and teacher centred with a high level of subject content) towards a 'competency' or 'outcomes-based' curriculum (learner-centred and focused on developing skills and capabilities).

South African schools have indeed experienced several curriculum changes over the years, and these changes have created challenges in one way or the other for the teachers who had to implement the curriculum (Leshwene & du Plessis, 2021).

Many teachers said that the constant changes and reforms in the curriculum are a big challenge to them; they also disorganised and stressed them because they did not know

how to execute the new curriculum (Ogunniyi & Mushayikwa, 2015). The frustration and worries they experienced negatively affected school learners' performance (Adu & Ngibe, 2014). However, based on research conducted by Adu and Ngibe (2014) to get the views of teachers' experiences regarding implementing a newly introduced curriculum, teachers said they were not involved in planning the new curriculum, nor were they part of the decision-making. For example, a teacher indicated their challenges in executing and implementing the National Curriculum Statement (NCS) effectively, including a lack of effective support from the education department. The teacher said they are expected to move from what they have practised and achieved and concentrate on the new policy statement brought to them (Adu & Ngibe, 2014).

The same scenario applied to the Curriculum and Assessment Policy Statement (CAPS) because some teachers complained of the language barrier as one of the challenges they faced in the implementation of the CAPS since English is regarded as the medium of instruction in most of the South African schools, especially in the rural areas and townships (Mbatha, 2016). Most of the learners in rural and township schools preferred their teachers to code-switch to their home language when teaching them because of their incompetency in English. However, from my experience as a classroom science teacher, it is very difficult for many science teachers to code-switch to learners' home language to explain the concepts and terminologies to their exact meanings (Sikhombo, 2018). Another problem the science teachers experience is a lack of pedagogical content knowledge and skills to meet CAPS-related challenges, such as setting up a practical class and forming investigative assessments for their learners (Du Plessis & Mbunyuza, 2014). Workshops were provided for the teachers, but they were not enough to prepare them for the challenges they encountered, instead, they practically just ensured that teachers understood the policy (Moodley, 2013).

According to Netshivhumbe and Mudau (2021), many South African science teachers have below-basic levels of content knowledge (CK), especially those teaching different science subjects, even though they specialised in one particular discipline or area in higher institutions. Teachers who teach outside their area of specialisation face many difficulties, such as a lack of pedagogical content knowledge (PCK), and insufficient

curriculum knowledge (Ali-Rweide, 2020). This view was also supported by the National Policy Framework for Teacher Education and Development, wherein it was discovered that South African teachers, more especially science teachers, are faced with the problem of inadequate and insufficient pedagogical content knowledge (Department of Basic Education [DBE], 2011), which therefore require the teachers to be more engaged in continuing professional development to eradicate or minimize the problem. It was also found that South Africa has some of the least-knowledgeable primary school science teachers in Sub-Saharan Africa. Many of these science teachers, especially those serving poor and rural communities, have below-basic pedagogical content knowledge (PCK) levels. In many instances, these teachers cannot answer questions their pupils are required to answer according to the curriculum (McCarthy & Oliphant, 2013).

The Limpopo Department of Education performed below the National performance benchmark percentage for almost five years. For instance, in the year 2018, Limpopo province obtained 70.6% as against 79.4% of national performance. In the year 2019, the Limpopo province received 73.2%, whereas the national performance was 81.3%. Furthermore, in 2020 the province measured performance of 68.2%, the national performance was 76.2%, and in 2021, the province obtained 66.7% while the national pass rate was 76.4%. Finally, in 2022, Limpopo province achieved 72.1%, while the national pass rate was 84.4%.

Table 1 table indicates the National and Limpopo province's performance in five (5) consecutive years (DBE, 2018; 2019; 2020; 2021; 2022).

COVID-19 has been identified as one of challenges the teachers and learners faced in 2020, which had a negative impact on Grade 12 performance in year 2020, 2021 and 2022 respectively, because teaching and learning were drastically affected (DBE, 2023).

Table 1.1: Limpopo Provincial Matric Performance

YEAR	NATIONAL PERFORMANCE (%)	LIMPOPO PROVINCE PERFORMANCE (%)
2018	79. 4	70. 6
2019	81. 3	73. 2
2020	76. 2	68. 2
2021	76.4	66.7
2022	84.4	72.1

Source: National School Certificate 2021 Examination Result, Analysis of NSC Examination Result (DBE, 2022)

From the above table of analysis of results comparing Limpopo's provincial matric performance and national performance, it is very conspicuous that the province is not achieving close to or above the average national performance but has a declining performance. In 2021 and 2022, Limpopo Province performed below all other eight (8) provinces in the country.

During the keynote address by the Minister of Basic Education, Mrs Angie Motshekga, MP, delivered at the release of the 2022 National School Certificate (NSC) Examination results on the 20th January 2022, she mentioned that policy changes negatively impacted the matric class of 2021. These policy changes included changes to the policy on progression, the discontinuation of the policy on Multiple Examination Opportunities (MOU), the offering of two (2) question papers in business studies and accounting, the offering of a third paper for all second additional languages, the addition of new subjects, such as dramatic arts, music, marine sciences, and the introduction of a practical assessment task (PAT) for technical mathematics, as well as changes in the structure and duration of some question papers (DBE, 2022). Furthermore, the Minister in her address during the release of the 2023 National School Certificate Examination result in January 2023, mentioned the impact of COVID-19 as it affected the 2023 NSC examination result because the 2022 matric class were in Grade 10 in 2020 (DBE, 2023).

Despite the challenges stated by the Minister of Basic Education, the Limpopo Department of Education is not the only province in the country where the policy changes were introduced, or the only province affected by COVID-19. Provinces such as the Eastern Cape and Kwazulu-Natal are more rural and have high populations of learners who sat for matric examinations every year improved their performances. The Limpopo province is better positioned geographically than the two provinces mentioned above because it shares boundaries with Gauteng and Mpumalanga provinces; these two provinces are performing well, especially Gauteng province. One can ask: What are the steps Limpopo provincial education department is not taking? What steps is the Limpopo provincial department of education supposed to take?

Furthermore, it was not just that Limpopo provincial education department performed below the overall national benchmark for five consecutive years, it was also discovered that the province performed below national pass percentage in Life sciences for five consecutive years.

Table 1.2: Limpopo Provincial Matric Performance in Life sciences

YEAR	NATIONAL PERFORMANCE IN LIFE SCIENCES (%)	LIMPOPO PROVINCE PERFORMANCE IN LIFE SCIENCE(%)
2018	79. 4	70. 6
2019	81. 3	73. 2
2020	76. 2	68. 2
2021	76.4	66.7
2022	84.4	72.1

Source: National School Certificate 2022 Examination Report, 2022 (DBE, 2022)

Table 1.2 clearly revealed that the performance of Limpopo province from 2018 to 2022 were below the national pass percentage in Life sciences. In year 2020 and 2021, the province results in Life sciences were below 70%. Whereas, the province managed to

obtained few percentages above 70 in year 2018, 2019 and 2022 respectively. Yet, the province did not perform above the national performance in Life sciences. Consequently, Limpopo department of education was keen to improve the matric results of the province.

Therefore, in order to improve the learners' results in Limpopo, the Limpopo Department of Education organised a 'Limpopo Curriculum Lekgotla' held in Tzaneen, where they discussed and perused the curriculum delivery challenges facing the province because of the persistent decline in Grade 12 final results.

To develop a curriculum roadmap that addresses the challenges and to achieve the expected goal in improving the quality of education, a draft discussion document with six 'pillars' that would guide the conversation was presented. The 'pillars', according to Limpopo 2024/5 Curriculum Roadmap presented for discussion at Curriculum Lekgotla, are as follows:

Pillar 1: Strategy to Universalise Access to Early Childhood Development (ECD).

Pillar 2: Learner Attainment Strategies to enhance learning performance levels

Pillar 3: Assessment Policy Framework and Guidelines to raise quality and standards of assessment

Pillar 4: Limpopo Educator Development Policy Framework and Model to institutionalise high teaching competencies.

Pillar 5: Limpopo Inclusive Education Rollout Plan to build a more equitable, high performing education system

Pillar 6: Limpopo e-Education Strategy to explicitly supply virtual and online spaces to enhance learning performance

Nonetheless, it was incredible to notice that under their discussion on Pillar 4, 'Limpopo Educator Development Policy Framework and Model to institutionalise high teaching competencies, the participants (LDE officials) identified continuing professional teacher development (CPTD) as a vital and important tool to improve the quality of teachers and teaching (Limpopo Department of Education, 2019).

It should be borne in mind that teachers play an important role in education as they are at the centre of the learning process. More so, they are expected to educate qualified individuals who are then needed by their country to take responsibility for the country's development (Uzal & Erdem, 2020). To achieve this responsibility, teachers must be experts in the teaching processes. In this aspect, I believe that teachers must continuously learn and develop themselves in their profession and maintain their proficiency throughout their lives. Learners can acquire the knowledge and skills used extensively in the twenty-first century when the professional development of teachers is carried out according to current criteria (Uzal & Erdem, 2020). In addition, I believe professional development activities should be designed to meet the teachers' needs and assist and provide them with the necessary skills. Many teachers have found their voices, saying that some CPD activities did not fulfil their needs or assist them (Mansour et al., 2014). This means that there is a gap between the needs of the teachers towards improving curriculum delivery and the nature of CPD programmes designed to assist them. For a CPD to be effective, it must address the needs of the teachers and improve their classroom practices in terms of curriculum implementation. Against this background, the following section presents the study's theoretical framework.

1.3 THEORETICAL FRAMEWORK

This section articulates and describes the theoretical framework employed in this research study. A theoretical framework serves as an epistemological guide or an appraisal that helps to interpret the knowledge and or data presented in a study. It also provides the researcher with a pathway to explore ideas and provide an understanding of what is happening (Richards & Morse, 2013).

The theoretical framework is a guide that assists a researcher in building their study or research inquiry (Grant & Osanloo, 2014). It is, therefore, easy to say that a theoretical framework assists the researcher in finding a proper research approach, analytical tools, and methods for their research study (Akintoye, 2015).

For this study research, the socio-constructivist theory is the most appropriate theoretical framework. The socio-constructivist theory demonstrate that knowledge is perceived as

socially constructed and learning as a social process mediated through cultural tools such as language; and facilitated by drawing on the contexts familiar to the learners (Westbrook et al., 2013). In order to apply the theory of socio-constructivist whereby science teachers can improve their pedagogical content knowledge to implement and deliver their subject curriculum effectively, a CPD programme was designed for the science teachers and presented to them through an organised workshop. The purpose of this designed CPD programme is to improve the teachers' pedagogical content knowledge and skills and enhance their profession. The teachers will work together during the workshop, sharing expertise, ideas, knowledge and skills. Within this framework, learning is believed to be a social process aided by social interactions and communication, leading to cognitive development.

In this study, I want to understand how socio-constructivist theory can effectively assist science teachers in improving their curriculum implementation in their respective classrooms through CPD programmes.

1.4 ELUCIDATION OF CONCEPTS

1.4.1 Basic concepts

For this study, the following have been identified as the basic concepts:

1.4.1.1 Curriculum delivery

Curriculum delivery is an approach whereby a curriculum enables learners to achieve their learning goals (Amravati, 2015). Amravati mentioned the processes of curriculum delivery, including teaching, learning support, guidance, counselling, mentorship, interaction, participation, collaborative learning, reasoning skills, feedback, and assessment. In addition, curriculum delivery is a continuous process, starting from the issuing of policy at the national level by the DBE, followed by the procurement and delivery of resources and the provision of support materials to schools by provinces and districts. This process will be continued by school leaders through the organisation and management of time, human and material resources towards teaching and learning activities which are coordinated by teachers in classrooms (DBE, 2021).

1.4.1.2 Curriculum implementation

Curriculum implementation can be defined as the act of working out plans and suggestions or recommendations that have been made by curriculum specialists and subject experts in a classroom or school environments (Selvan, 2021). Bediako (2019), describes curriculum implementation as to how the planned or officially designed course of study is translated by the teacher into syllabuses, schemes of work and lessons to be delivered to learners. There are various factors that influences curriculum implantation such as, resources, the teacher, school environment, culture and ideology, instructional supervision and assessment (Bediako, 2019). Curriculum implementation process involves helping the learners to acquire knowledge and experience which are delivered to them by the teachers. Therefore, the teachers are referred to as curriculum implementer (Selvan, 2021).

1.4.1.3 Continuing professional development

Oxbridge Academy (2017) defines CPD as a term used to describe learning activities that professionals participate in to develop and enhance their skills. Continuing professional development is the continuing development of professionals in their working career to improve and expand their knowledge and skills to enable them to perform effectively in their profession (Khan, 2021).

1.4.1.4 Grade 10 learner

Learner means any person receiving education or obliged to receive education in terms of this Act (The Presidency, 2011). In this study, a learner is any person whose responsibility is to receive formal education. A learner can also be referred to as a person who attends an Early Childhood Development (ECD) Centre, School or Adult Basic Education and Training (ABET) Centre (DBE, 2010).

1.4.1.5 Science teachers

Science teachers teach learners the important concepts of scientific procedure and principle (ZipRecruiter, 2003). They disseminate existing knowledge, not working on

creating new knowledge but disseminating the knowledge that has been created (Teachmint, 2023).

1.4.1.6 Science subjects

Science is an important academic discipline which includes a range of subjects such as biology, chemistry, physics, mathematics and agriculture (Homden, 2017). One must understand concepts and relate to them in writing (Ngema, 2016).

1.4.2 Related concepts

The related concepts that are used in this study are as follows:

1.4.2.1 Collaboration

Collaboration can be described as working together to develop solutions of practical problems to increase the total value of a professional career (Sharratt & Planche, 2016). It has been proven by Khan (2021) that teachers who worked collaboratively increased their classroom practices. Collaboration is also a process of two or more people working together to perform or do a particular task (National Association of School Change Entities in Education [NASCEE], 2019).

1.4.2.2 Curriculum

A curriculum stipulates what the teachers should be teaching, what the learners should be learning and how they learn (Su, 2012). In this study, a curriculum concentrates on secondary schools. In addition, the curriculum is referred to lessons and academic studies taught in an institution or a specific programme. It is described as all intentionally or unintentionally selected, structured, inclusive, resourceful, and summative educational issues that are provided to learners under the guidance of the school to achieve particular learning outcomes that are attained as a result of advancement, development, and acquiring of knowledge that is highly suitable for life in a varied society (Mulenga, 2018).

1.4.2.3 Curriculum change

Curriculum change is a process of changing the curriculum to make learning and teaching more productive by using resources effectively to improve the curriculum (Yasmin, Rafiq

& Ashraf, 2013). In this study, curriculum change means first moving from Bantu Education to C2005, which was based on OBE, to the NCS and now to CAPS

1.4.2.4 Education

Education can be described as a process of facilitating learning or the acquisition of knowledge, skills, beliefs, values, and habits (UNESCO 2021a).

1.4.2.5 Performance of learners

This is the integration of demonstrations of cognitive reasoning, affective and manual activities, e.g., science practical or the achievement of specific observable and measured tasks (DBE, 2013). For this research study, the performance of learners is measured based on the promotion requirements for Grades 10-12 as stipulated in the National Policy Pertaining to the Programme and Promotion Requirements of the NCS Grade R-12 (DBE, 2011d).

1.4.2.6 Rural area

A rural area is a geographic area located outside cities and towns. Furthermore, by definition, rural areas are characterised by geographic isolation and small population size (Gardner, 2006).

1.4.2.7 Rural School

Low population density together with family isolation and community remoteness, uniquely characterise rural areas (Redding & Walberg, 2012).

1.4.2.8 Secondary School Teacher

A teacher is a person who possesses an approved and recognised professional teaching qualification for employment in public education to teach, educate or train other persons or to provide professional educational services (DBE, 2010). Mantei, Lipscombe, Cronin and Kervin (2019) describe a secondary school teacher as a professional in the field of education responsible for teaching or tutoring; they are involved in the practice of teaching and learning, as well as responsible for designing learning experiences. In the context of

South Africa, a secondary school teacher teaches learners from Grade 8 to 12 specialising in one or two subject areas.

1.4.2.9 Qualification

Qualification can be described as an official recognition of the achievement of the required number and range of credits, and requirements of a specific level of the NQF as determined by the relevant bodies registered for such purposes (Republic of South Africa, 2008). In South Africa, a qualification is registered by the South African Qualifications Authority (SAQA).

1.5 PROBLEM STATEMENT AND RESEARCH QUESTIONS

Many countries, such as Saudi Arabia, the United States of America, and Zimbabwe, have experienced changes or reforms in their education curriculum (Maharajh, Nkosi & Mkhize 2016). Unfortunately, these changes have adversely affected the implementation and delivery of effective and quality curricula by teachers (Horsthemke, Siyakwazi, Walton & Wolhuter, 2013). In South Africa, education stakeholders such as teachers, school principals, education district officials, professional bodies, parents, and Departments of Education are concerned about the nature of the curriculum implementation in South African schools. Research studies, for example, a study on the Norms and Standards for Educators (Department of Education, 2007), reveal that for a curriculum to be effectively implemented the teachers must be well-equipped professionally. Unfortunately, many teachers are not skilled or specialised or lack the required knowledge to teach the subject (Jita & Mokhele, 2014). For example, many of the science teachers teaching natural sciences in the 'Senior Phase' (Grades 7-9) deliver sub-standard lessons in their classrooms (Mizzi, 2013; Motlhabane, 2013). Natural sciences as a multifaceted subject incorporated three key science subjects, namely, physical sciences, Life sciences and geography. A teacher specialising in Life sciences may be unable to teach natural sciences effectively because all other incorporated subjects will be poorly taught. Unfortunately, these teachers are obliged to teach natural sciences in Grade 7-9 despite their non-specialisation in the other subjects incorporated therein. I am convinced that the subject can only be taught effectively if the school has a well-trained and qualified teacher.

Furthermore, the language of science seems to be a major problem for many science teachers. Some do not understand how to explain or define some terms, concepts and vocabulary to the learners in simple language. Hands-on activities are embedded into science teaching and learning (DBE, 2014). It is disappointing to see science teachers unable to handle science apparatus. They cannot organise practical classes to demonstrate experiments to their learners.

Nonetheless, teachers do complain of a lack of support and mentorship from their School Management Team (SMT), School Governing Body (SGB), Department of Education (subject specialists in the districts and provinces) and society because the continuous changes in the curriculum negatively affect effective teaching and learning (Adu & Ngibe, 2014).

From this background it is clear that teachers need development, mentorship and support particularly in pedagogical content knowledge as well as in teaching strategy, classroom management, assessment and feedback. This professional development can be achieved through interactive and effective CPD programmes as postulated by the Integrated Strategic Planning Framework for Teacher Education and Development in South Africa, 2011-2025 (ISPFTED) (DBE, 2015). The ISPTED compounds this notion further by indicating that even though the CPD programmes exist in the South African education system, they are not structured to support teacher learning and professional growth. This misalignment, unfortunately, devalues the desired interventional support to address the challenges of a lack of required knowledge and teaching skills experienced by the teachers. The reason being that there is a gap between what the teachers really needed to improve their curriculum implementation and the nature of the CPD programme designed to assist for them. For a CPD to be effective, it must accommodate or be designed in such a way that it addresses the teachers' challenges and needs.

However, focusing on science teachers from selected secondary schools in Ngwaritsi Circuit, Sekhukhune district in the Limpopo province, this study explores and establishes how CPD programmes can contribute and assist Grade 10 science teachers teaching Life sciences in improving curriculum delivery and implementation. As indicated in the

introduction, to achieve this, I interviewed (pre-semi-structured interview) the participants (science teachers) by asking them various questions regarding the subject they teach and any challenges they might be facing. I also observed their lesson presentations (pre-observation); after that, a CPD interventional workshop was organised for them to address all the challenges they mentioned, wherein I acted as a facilitator and mediator to plan and implement the sessions. After the workshop, I observed the teachers' lesson presentations (post-observation) and interviewed them to get their views (post-semi-structured interview) pertaining to the interventional programme/workshop.

1.5.1 Main research question

The main research question can be stated as follows:

What is the Grade 10 science teachers' understanding and perceptions of CPD programmes as an intervention to improve their curriculum implementation?

In light of the main question, the following sub-questions serve as key foci for the research study.

1.5.2 Sub-research questions

Some sub-research questions were posted to address the main research question, as follows:

1 What are the challenges science teachers encounter in curriculum implementation?
2 What are the needs of science teachers for CPD programmes?
3 How do proposed CPD programmes assist science teachers in their curriculum implementation?

1.6 AIM AND OBJECTIVES OF THE STUDY

The research aim addresses the primary research question, while the objectives are formulated to answer the secondary research questions.

1.6.1 Aim of the study

The aim of the study is to explore and establish the Grade 10 science teachers' perceptions of CPD programmes as support for an intervention to improve their curriculum implementation and to propose a model to illustrate the use and advantages of a CPD programmes or activities.

1.6.2 The Objectives of this Study

This proposed study is guided by the following objectives:

1 To understand the challenges science teachers' encounter in curriculum implementation.
2 To establish the needs of CPD programmes by science teachers.
3 To explore and understand how CPD programmmes assist science teachers in curriculum implementation.

1.7 RESEARCH METHODOLOGY

In research, the methodology provides the norm for conducting, designing, planning and organising the research study (Mohajan, 2017). A good research methodology must have clearly enunciated and overarching procedural outlines that include research questions, design, data collections, analysis of data and reporting of results (Creswell, 2014).

1.7.1 Research design

A research design allows a researcher to take absolute control over the variables that should not negatively influence the validity of the research (Creswell, 2013; Datt, 2016; Dinnen, 2014). In addition, a research design is a complete process where research is conducted that is constituted for measurement (Mohajan, 2017). Amongst the functions of a research design is identifying and developing specific processes and methods of the research plan of action to conduct the research study. Above all, it sets out the procedures by ensuring that the design is valid and accurate and outlines the objectives to be achieved (Okeke & van Wyk, 2015). This study is an exploratory research design. The purpose of an exploratory research is to achieve new insights into a phenomenon and

formulate a problem for a more accurate investigation or for developing a hypothesis (Islamia, 2016).

However, a Participatory Reflection Action (PRA) method is adopted. Participatory Reflection Action is ontologically rooted in an interpretative paradigm as one collects data from the workshops and analyse and interpret the data collected. Regarding this study, the researcher focuses on exploring the views and experiences of the Grade 10 science teachers teaching Life sciences on continuing professional development programmes, which are conducted through workshops, and whether they improve their curriculum implementation. The research methodology was however discussed in detail in Chapter 4.

1.7.1.1 Interpretivist research paradigm

A research paradigm is an ideological or philosophical stance that guides a study, based on three commonly used ontological paradigms: positivism, interpretivism and pragmatism (Leavy, 2017). Interpretivism pays attention to the human interpretation of the social world, including the importance of both the researcher's and participants' interpretation and understanding of the phenomenon being studied (Ritchie et al., 2013). Therefore, interpretivism is the most relevant paradigm for this study because it is concerned with exposing multiple realities against seeking only one reality (Guest, Namey & Mitchell, 2013). This study did not only focus on one school, but instead on three different schools. Interpretivism also assists in looking at situations from the participants' perceptive (Tracy, 2013). In a nutshell, I did not only interview the science teachers after the intervention CPD programme, but also observed their lesson presentations to explore their views regarding how CPD programmes improve their curriculum implementation.

1.7.1.2 Research approach

The research approach seeks to understand human and social behaviour. Therefore, individual and group social actions, beliefs and perceptions are described to achieve this understanding (MacMillan & Schumacher 2014).

A qualitative research approach is used to seek answers to the research questions as deeply as possible. This approach is chosen because the research concerns a phenomenon's qualities, characteristics and properties because a qualitative approach allows the researcher to pay attention to actions performed. The actions include reading and listening to words in all their complexity as they take place in a natural setting or in a real context (Nieuwenhuis, 2016). A qualitative approach is relevant for this study as it explores and establishes how CPD programmes can assist Grade 10 science teachers teaching Life sciences in improving their curriculum implementation.

1.7.1.3 Research strategy

This study adopts a multiple case study since the research is designed to enable the researcher to cultivate an in-depth analysis of a case (Creswell, 2014). In a case study, the researcher focuses on a particular case with special characteristics (Atmowardoyo, 2018). A case study is very useful when the researcher is exploring an area where he wants to have a holistic understanding of a phenomenon (Kumar, 2018). It is in this light that the 12 schools which I chose were within the same education circuit in a rural area. The circuit is regarded as a case wherein the 12 schools are under one circuit. The study focuses on science teachers in the 12 selected schools in the same circuit. These teachers were grouped into three different centres based on their proximity and convenience; in each of the centres, data were collected from the teachers individually.

1.7.2 Research method

This section deals with the selection of participants, data collection techniques and data analysis. The research method is a logical procedure a researcher uses to conduct research and solve the defined research questions (Atmowardoyo, 2018).

1.7.2.1 Selection of participants

The participants for this study are science teachers who are currently teaching Life sciences in Grade 10. Each of the participants was chosen from twelve selected secondary schools in the Ngwaritsi circuit, Sekhukhune South district, Limpopo Province. As a researcher, I purposefully selected all the schools within the same circuit. The selection of the schools was based on their academic performance, and they were

grouped into categories, i.e., above performer – category A, average performer – category B, and below average performer – category C. Each category mentioned consisted of science teachers based on their school's performance. For example, category 'A' – (above average performer) consisted of three (3) teachers, category 'B' – (average performer) consisted of four (4) teachers, and category 'C' – (below average performer) also consisted of five (5) teachers. A total of twelve (12) Grade 10 science teachers teaching Life sciences formed the population of this study. Details on the participants' selection will be explained in Chapter 4.

1.7.2.2 Data collection

For this study, data were collected through interviews and observations.

i. Individual semi-structured interviews

An interview is a social inter-personnel encounter and not just about the collection of data; it is a flexible instrument for data collection that enables multi-sensory channels to be utilised, such as verbal, non-verbal, observed, spoken, heard, and of course, online interviews and written (Cohen, Manion, & Morrison, 2018).

An in-depth, individual semi-structured interview for 12 Grade 10 science teachers teaching Life sciences was used. This data collection instrument was important for me because it explores issues, personal biographies, what is meaningful to or valued by participants, what they know about a topic, what they have experienced, how they feel about particular issues, how they look at particular issues, their attitudes, opinions and emotions (Mears, 2012). The use of one-on-one open-ended interviews further allowed the participants (interviewees) the opportunity to expatiate on how they saw or felt about things. I conducted an individual semi-structured interviews with the Grade 10 science teachers teaching Life sciences since they are the curriculum implementers who must deliver quality content to their learners. It is important to note that the interviews are divided into two parts; pre- and post-semi-structured interviews. I designed an interview schedule which contained the questions asked in the pre- (*Appendix H*) and post-interviews (*Appendix J*). The semi-structured interviews were audio-recorded and transcribed by me and will be kept for at least three years.

ii. Individual lesson observation

An observation is far beyond just looking; it is strong on face validity which can provide rich contextual information, allow the first-hand collection of data, disclose mundane routines and activities, and provide documentation opportunities of those aspects of life worlds that are verbal, non-verbal and physical (Cohen et al., 2018).

I observed the lesson presentations of each of the participants before and after the CPD interventional programme. Thus, the observation was divided into two parts; pre-lesson observation and post-lesson observation. I developed an observation schedule (Appendix I) to determine the focus during the exercises. In addition, the observation process was video-captured for better reflections when reporting or transcribing the information.

1.7.2.3 Data analysis

Data analysis is one of the crucial parts of any research study, it involves data gathering, ordering, labelling, printing, and in some instances, it also requires reformatting (Tracy, 2013). In this study, the semi-structured interviews and lesson observations are transcribed verbatim, followed by coding, classification and categorisation used to analyse the data collected.

1.8 MEASURES FOR TRUSTWORTHINESS

Joko Gunawan (2015:4) cites that “qualitative researchers must use credibility, transferability, dependability and confirmability to evaluate and ensure the trustworthiness of results in qualitative research”. For the purpose of this research study, I explained how the measures of trustworthiness were applied.

1.8.1 Credibility

Credibility in qualitative research entails trusting the researcher’s findings as accurate (Korstjens & Moser, 2018). This trust implies that the researcher is convinced their findings are truthful and correct.

To ensure credibility, I remained objective at all times and did not influence the participants’ answers in any way during data collection. However, lists of interview

questions were prepared by me based on the literature and theory to answer the research questions. Above all, I made sure that the audio recordings of all the semi-structured interviews were retained by me.

1.8.2 Transferability

Transferability can be described as the degree to which the results of qualitative research can be transferred to other contexts or settings with other respondents (Korstjens & Moser, 2018). I describe the steps taken in the research study regarding the conduct and findings in detail so that if someone else wanted to do a similar study in another context, such a person would have in-depth knowledge of the parameters needed to determine the transferability of the research to the intended context.

1.8.3 Dependability

Dependability implies obtaining the same result if the study were to be repeated (Forero, Nahidi, De Costa, Mohsin, Fitzgerald, Gibson, MacCarthy & Sarfo, 2018). The researcher ensures data integrity by keeping more than one copy of the same data on different storage devices, such as on a laptop, memory stick or compact disc, while the hard copies are kept in a locked filing cabinet having one key.

1.8.4 Confirmability

Confirmability means that others can confirm the results obtained. This means that data and interpretations of the findings are established and not fabrication of researchers' imagination, but they are clearly obtained from the data (Korstjens & Moser, 2018). The researcher, therefore, makes sure that data are not just collected from one science teacher and one school, but the data collection takes place in 12 different schools and from the science teachers in those schools. This approach allowed the researcher to get the teachers' different perceptions or views towards CPD programmes and the curriculum delivery in their subject. Furthermore, the researcher ensured during the interviews to remain unbiased to avoid the contamination of the data with his personal perception, views and previous knowledge on the subject.

1.9 ETHICAL CONSIDERATIONS

Ethical principles such as avoidance of plagiarism and data falsification, informed consent, confidentiality, respect for the individual and avoidance of misrepresentation of the collected data were absolutely considered throughout the data collection process. Moreover, this procedure was maintained throughout the research process. All sources consulted will have been acknowledged to guide against plagiarism.

Moreover, I applied to Unisa's College of Education's ethics committee requesting ethical clearance. A permission request letter was sent to the Limpopo Department of Education to conduct the research study; also, a letter requesting permission was sent to Ngwaritsi Circuit. Finally, all the participants were written to ask for their participation in the research, and they all signed the consent form. The participants were informed about Unisa's ethics guidelines that guided the research study and were briefed in detail about the content of the questions posed. They were assured that their information would be treated with respect, ensuring their identities were protected and that their responses would remain anonymous.

1.10 CHAPTER DIVISION

The structure of the study illustrates descriptive features in each of the six chapters.

Chapter 1: This chapter presents the introduction and a brief overview of the background of the research study. The theoretical framework, the elucidation of concepts, problem statement, aims and objectives are discussed. In conclusion, this chapter discussed the research methodology, measure for trustworthiness, ethical considerations and chapter division.

Chapter 2: This chapter presents the contextual framework of the study and outlines an in-depth literature review of curriculum delivery and continuing professional development programmes.

Chapter 3: This chapter focuses on the theoretical and conceptual framework that underpins the study.

Chapter 4: Chapter 4 presents the research methodology, research design deals with the research paradigm, approach and research type. The research method will include procedures, tools and techniques to gather and analyse data. Trustworthiness and ethical consideration regarding the participation of human beings in this study are discussed.

Chapter 5: This chapter presents the data analysis, and interpretation of the empirical research. This comprises of detailed discussions on the findings of the data collected. Above all, it includes comparisons of findings with literature.

Chapter 6: This chapter comprises of detailed discussions on the findings of the qualitative data. This chapter concluded by providing recommendations based on study findings, remarks, and limitations to the study.

1.11 CHAPTER SUMMARY

This chapter serves as an orientation to the whole study. The background of this study is contextualised on South African science teachers in Grade 10 regarding their curriculum delivery in classroom and their perceptions towards CPD programmes. It was revealed that the science teachers have challenges in implementing curriculum especially because of constant changes or reforms in the curriculum that happened in the country.

The next chapter outlines an in-depth literature review, consisting of the contextual framework.

CHAPTER 2

CURRICULUM IMPLEMENTATION AND CONTINUING PROFESSIONAL DEVELOPMENT PROGRAMMES IN CONTEXT

2.1 INTRODUCTION

This chapter will present a review and discussion on the overview of curriculum implementation and reform. The chapter illustrates the historical overview of curriculum changes internationally, as well as the South African context. The chapter extensively discusses the curriculum reforms in South Africa in both the pre- and post-democracy eras. It further explains frustrations experienced by education stakeholders, particularly the curriculum implementers. In addition, CPD and its programmes are extensively discussed in Chapter 2. The literature review in the chapter further explains the CPD programmes and their impact on curriculum implementation.

Above all, the purpose of this chapter is to generate and give an overview of the contextual framework, including citations, and the outcomes of other studies that are closely related (Creswell, 2013).

2.2 AN OVERVIEW OF INTERNATIONAL EDUCATION SYSTEMS: CURRICULUM IMPLEMENTATION AND REFORMS

Countries have different ways of implementing their educational curriculum leading to curriculum changes or reforms. Curriculum changes are driven by attempts to prioritise curricula focusing on skills, application, and problem-solving (Maharajh et al., 2016).

Many developed countries experienced curriculum changes, such as the United States of America (USA) in the 1970s. In the USA, the changes in science and mathematics curriculum were consistent. They aimed to augment national security against the East even though criticisms were levelled against the educational reforms in science, which brought about serious concerns (Maharajh et al., 2016).

However, the report of research conducted by the National Institute for Education Research (1999), titled “An International Comparative Study of School Curriculums”,

listed some factors that could influence curriculum reforms or changes in a particular country. Furthermore, the report mentioned that the factors include social, economic, political, and cultural change. The findings of this report were also supported by Maharajh et al. (2016), wherein they indicated that curriculum changes can be driven by economic, political and social factors. Nonetheless, in order to build social cohesion and national identity in the global society and to preserve cultural heritage, Australia and Germany reformed their curricula to achieve their objectives (National institute for educational research, 1999). The United States, Australia, New Zealand, and Uzbekistan also changed their educational curriculum to ensure future economic well-being and international competitiveness (National institute for educational research, 1999).

Apart from the factors listed by the National Institute for Education Research (1999), other known factors can cause a change to the curriculum in a country, such as learners' performance, and pedagogical content knowledge, while teaching methodology might be among other key factors that can lead to curriculum change of schools (Adu & Ngibe, 2014). For example, in Saudi Arabia, learners' performance and teachers' teaching methodology contributed to a reform in the country's school curriculum. These reforms were informed by the Trends in International Mathematics and Science Study's (TIMSS') results in both 2003 and 2007, indicating that students' science performance was inadequate (El-Deghaidy et al., 2014). A new science education curriculum was adopted, which translated and modified the McGraw-Hill guidelines about the environmental and philosophical context of Saudi society, where teachers were to move away from traditional teaching methods to hands-on engagement.

In Sub-Saharan Africa, curriculum reform is inevitable because judging from history, Africa was colonised by Western countries, but after the independence from the colonisers, African leaders saw the need to restructure and redesign their curriculum. In response to the importance of curriculum changes, countries in the North African and West African region have initiated political and educational reforms in the 1990s (Akkari & Shafei, & Lauwerier, 2012).

Algeria, Morocco, Tunisia, and Mauritania have been committed to curriculum reforms after their independence. The governments were keen to improve the quality of learners' learning. As a result of the commitment, this has urged the North African ministries of Education to expediently carry out essential reforms with the support of international organisations, UNESCO, and experts (Akkari et al., 2012).

Several African countries have used different methods to reform their curricula by improving the quality of learners' learning. However, many of these countries have adopted the use of a competency-based approach. The curriculum changes based on competencies were first implemented in the northern francophone countries, i.e. Belgium, Switzerland, and Quebec, Canada (Akkari et al., 2012).

Adu and Ngibe indicate that

> *"curriculum change affects the lives, relationships, and working pattern of teachers, and the education experiences of learners. It affects parents by altering the education which their children receive and thereby confirming or challenging their own expectations of what school should look like. It affects the community at large, which aware of the school through the outward conduct and attitude of pupil, rightly or wrongly understood".* Adu and Ngibe (2014:5)

In my opinion, the above statement by Adu and Ngibe is based on the fact that curriculum change involves the introduction of a new discourse about education, and it takes time for people to understand and get used to its implementation.

Implementation of quality and effective curricula in countries such as Tanzania and Kenya was hampered by effective pedagogy, as revealed in the annual Education for All Global Monitoring Reports, established in Dakar, Senegal, in 2000, because the training that student teachers receive at the initial teacher education (ITE) stage in Sub-Saharan Africa is far below standard (Hardman, Hardman, Dachi, Elliot, Ihebuzor, Ntekim & Tibuhinda, 2015). Tanzania, for example, must reform its curriculum to improve poor education implementation.

In addition, South Africa is not exempted from being among the countries that experienced constant changes in curricula. There are several curriculum changes that South African schools have experienced over the past decades (Letshwene & Du Plessis, 2021). However, curriculum delivery and implementation in South African schools is still a great concern to many education stakeholders as teachers often complain of multifaceted curriculum design, poor instruction, absence of support, insufficient time for execution and shortage of learning materials (Gumede & Biyase, 2016). The concerns identified by the education stakeholders, especially from teachers, have unfortunately resulted in continuous curriculum reform to mitigate the challenges.

2.3 SOUTH AFRICAN EDUCATION SYSTEM: PRE-APARTHEID

South Africa is a multicultural and multilingual society, and the educational system of the pre-democratic government was significantly characterised by inequalities in the distribution of resources and curricula offered and was demarcated by language and race (Spaull, 2013). At that time, the educational system was established by the apartheid regime, and funded and resourced in such a way that white people benefitted more than black people (Gardiner, 2008; Ogunniyi & Mushayikwa, 2015). The dominant white governments most of the resources to the education of white learners, while Indian, coloured, and black learners were provided fewer resources, starting from about two-thirds for Indians to about one-quarter for black African learners, respectively, compared to their white counterparts (Ogunniyi & Mushayikwa, 2015). In a nutshell, the apartheid government established many different education departments for managing the allocation of resources to white and non-white learners. The quality of education for black children was very poor, denying them access to well-paying jobs (Spaull, 2013).

This model idea was made possible through the introduction of Bantu Education established by Dr W.M. Eiselen and Dr Hendrik F. Verwoerd (minister of native affairs). They were assigned to develop a curriculum for black children, which would be far inferior to that of white children. Hence, they created a Black Education Department in the Department of Native Affairs (South Africa, 1953)). The main objective was to deprive black children of accessing quality education that could place them in good positions in

society, but instead, they were relegated to menial jobs under the control of the whites (South Africa, 1953).

The effect and heritage of Bantu education, which affects a 'homeland' area, as it was previously called, was highly noticeable. The schools in homeland areas were dilapidated because of a lack of funding and support (Botha, Devereux, Adendoff & Sotuku 2006).

According to Youth Group Fact Sheet 1, Bantu Education gave the pre-democratic regime power and control over black education. Bantu Education funding was taken from the general government budget and connected directly to the taxes paid by the pre-democratic government (Youth Group Fact Sheet 1, 2011). Consequently, less money was spent on black children's education than on white children's education (Ogunniyi & Mushayikwa, 2015).

Therefore, the South African black children received a sub-standard quality of education which strengthened social inequality amongst the races, leading to a state where children themselves inherited the social status of their parents (Spaull, 2013).

This model was followed in the South African education system under the apartheid government until 1994 when a new democratic government was elected and took power in the country.

2.4 SOUTH AFRICAN SCHOOL CURRICULUM CHANGES: POST-APARTHEID

The educational changes were influenced and catalysed by political changes in 1994. Consequently, the political changes led to the abolition of apartheid and the introduction of a democratic South Africa. The educational desire that emerged after the collapse of the apartheid government was to integrate education and training into a system of lifelong learning. South Africa, therefore, embarked on radical education reform (Adu & Ngibe, 2014).

The new democratic government of Dr Nelson Mandela after the 1994 election began with curriculum changes. The nineteen pre-democratic departments of education were

abolished. They were replaced with nine non-racial provincial departments of education and one national department (DBE, 2008).

Jansen and Taylor argued that the factors which propelled change of the curriculum included the objective of making the economy globally more competitive and meeting the government's outlined goals of equity, redress, democracy, access and participation (Jansen & Taylor, in Gumede and Biyase, 2016).

It was believed that the apartheid era educational curriculum was too academic and needed to be modernised because it seemed not to prepare students for global work and democratic society. The aim was that as a South African worker, one should not expect the same job throughout one's lifetime; hence one must be flexible and equipped with technological skills and the ability to learn the requirements of a new career self-reliantly. Moreover, one should be able to act responsibly and think critically as a citizen, which means that one should be a problem-solver with broad knowledge in dealing with everyday problems rather than just having an academic focus (Ogunniyi & Mushayikwa, 2015).

Nonetheless, the disestablishment of nineteen apartheid education departments gave birth to a progressive, outcomes-based pedagogy known as 'Curriculum 2005', which commenced its operation in all Grade 1 classrooms effective in 1998 (Gumede & Biyase, 2016). The curriculum placed the obligation for learning on the learners themselves, while the teachers were to serve as facilitators.

Curriculum 2005 or C2005 was regarded as being constructivist, in the sense that learners do not imbibe readymade knowledge from their teachers or a textbook, but instead they construct their knowledge through problem-solving activities or prognoses drawn from different sources, e.g., newspapers, the Internet, magazines, dictionaries, people, books, etc. This type of pedagogical approach is referred to as learner-centred or progressive. The learners take responsibility for their learning, working cooperatively in multilingual classrooms as well as using different resources as opposed to the teacher-centred or traditional approach where teachers are in charge of the teaching, which

involves the whole class using textbooks as one of the teaching materials (Ogunniyi & Mushayikwa, 2015).

Unfortunately, less than two years after the commencement of C2005, it started to experience serious problems, teachers complained of a multifaceted curriculum design, language complexity, absence of support, unproductive training, and inadequate time for execution (Adu & Ngibe, 2014).

The Curriculum 2005 implementation demands high capacity and resources because it is based on Western education, seen as the world-class standard. One should ask: Is South Africa equipped to meet the curriculum requirements of implementation for effective classroom practice? In my view, certainly not. The reason is that the curriculum, as good as it was, suffered some setbacks, a few of which have been mentioned above.

At the beginning of 2000, when it became evident that the operation of Curriculum 2005 was not continuing as planned, Prof Kader Asmal (the then Minister of Education) was tasked to investigate the challenges raised and faced in the execution of Curriculum 2005 and come up with remedy (Adu & Ngibe, 2014). After intense consultations with stakeholders, the Minister recommended that Curriculum 2005 be restructured, strengthened, and replaced with a revised version called the National Curriculum Statement (NCS). The best aspects of Curriculum 2005 were kept, and a simpler and stronger curriculum was developed, called Revised National Curriculum Statement (RNCS), introduced in 2002. It should be noted that RNCS is not a new curriculum but a restructuring and strengthening of Curriculum 2005.

Above all, curriculum 2005 went through a review due to technical problems encountered in its implementations and executions. The resulting curriculum from that was called RNCS, although it still retains the ideals, objectives, and principles of C2005 and upholds the commitment to Outcomes-Based Education (OBE).

In 2012, the Curriculum and Assessment Policy Statement (CAPS) was introduced in South African schools in Grade 10. The main reason for introducing CAPS is as a result of the challenges experienced with C2005 and NCS. The CAPS was aimed to strengthen

the NCS and to clearly specify what should be taught, which topics should be covered, and to provide guidelines on assessment (Letshwene & Du Plessis, 2021). In addition, CAPS was introduced to assist with reducing the administrative burden on the teachers and to clarify which topic was to be covered per subject, per grade, and per term according to the school calendar (DBE, 2015).

The Department of Basic Education developed a five-year strategy to support teachers in the implementation of CAPS through different programmes, which includes in-service training, but there are still ongoing concerns over the falling standards of South African schools through the failure of not addressing the problems of poor parental involvement, inactive school governing bodies and poor school leadership (UNICEF, 2018)

Thus, the curriculum changes in South Africa can be summarised as: C2005 was introduced in 1997 as a policy document as a remedy to replace the dismantled Bantu education, RNCS in 2002, NCS came in 2007, and finally, CAPS, which is currently in use, which was introduced in 2012.

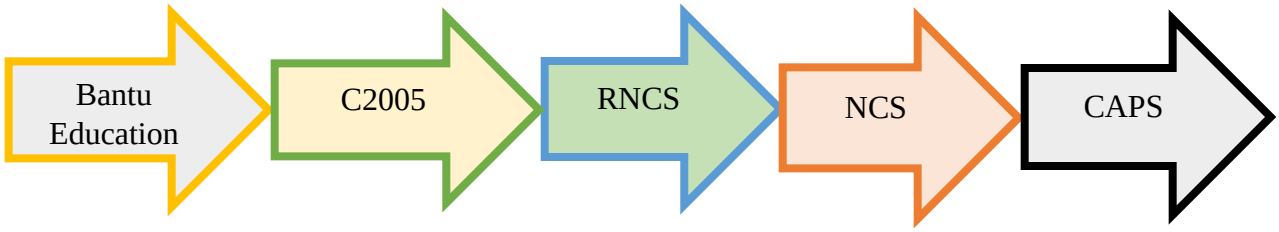

Figure 2.1: Pattern of Curriculum Changes in South Africa

2.5 TEACHER EDUCATION: PRE-APARTHEID

South African teacher education and training between the years 1910-1994 was established, funded, and resourced based on race. The races were classified as Whites, Blacks, Coloureds, and Indians. In addition, the government phased out the teacher-pupil system during this period for all races and introduced teacher colleges to take over the obligation of training teachers (Wolhuter, 2006).

Most white teachers received support from the government through pre-and in-service training at well-resourced urban universities, unlike most black teachers who started teaching without completing secondary school, not even mentioning attending tertiary

institutions (Ogunniyi & Mushayikwa, 2015). However, most African teachers willing to teach in primary schools were provided with training by mission schools (established and funded by the missionaries). Most White teachers received pre- and in-service training at well-resourced urban universities, while many of the Black teachers who started teaching then did not even complete their own secondary school education, not to mention tertiary education (Ogunniyi & Mushayikwa, 2015).

Therefore, during the apartheid regime, the Whites benefited more than any other race.

2.5.1 Whites – teacher education and training

As mentioned above, the government gradually phased out the teacher-pupil system and introduced teacher training colleges to train teachers, providing a specific medium of instruction for teachers.

According to Wolhuter (2006), the colleges were established in the provinces as follows:

- Cape Province - There were five teacher training colleges: Three Afrikaans-medium, one English-medium, and one dual medium.
- Transvaal - There were five teacher training colleges: Two English-medium and three Afrikaans-medium colleges.
- Orange Free State – Only one teacher training college, having Afrikaans as a medium of instruction.
- Natal Province – They had three teacher training colleges, where two were English-medium and one Afrikaans-medium.

Above all, the universities slowly began to be involved in training secondary school teachers, and subsequently, teacher training colleges were phased out. The high school teachers for White high schools were trained by the central government through universities (Botha et al., 2006).

2.5.2 Blacks – teacher education and training

As it applied to the Whites, the same applied to the Blacks; the government phased out the pupil-teacher system.

After 1948 many teacher training colleges were established in the homelands. The rationale behind establishing these colleges was not based on the need for trained teachers but because it was one of the few avenues of higher education for Blacks. The colleges were also a tool for competition among homeland leaders, becoming a source of status and patronage (Parker, 2002). More importantly, the apartheid government introduced Bantu education for the Blacks during this period. The educational curriculum of the Blacks was changed and became highly inferior to that of the Whites.

Around 1981, the homelands had about 37 training colleges for Black teachers, which later increased to about 120 by 1994 (Vos & Barnard, 1984; Parker, 2002). In the early 1990s, the increase in Black teacher training colleges caused an abnormal situation, resulting in an enormous number of unemployed teachers. In 1994, 120 teacher training colleges and 32 universities and Technikons offered teacher education to an outrageous number of about 200,000 students (Botha et al., 2006).

Unfortunately, Black schools had many unqualified or underqualified teachers already in the system before the addition of excess teachers. Similarly, like the Whites, the Black universities in homelands also began to train secondary school teachers.

2.5.3 Coloureds – teachers' education and training

Just like the Whites and the Blacks, pupil-teacher training for the Coloureds was also phased out and replaced by training colleges, which trained both primary and secondary school teachers.

In 1961, the University of the Western Cape that trained secondary school teachers came into being for the Coloured population or race (Wolhuter, 2006).

2.5.4 Indians – teachers' education and training:

In 1951, the Springfield Teacher Training College was established in Durban, Natal, and Laudium (Transvaal). The colleges were established to train both primary and secondary school teachers.

In 1961, the University of Durban-Westville was established for Indians to train secondary school teachers (Wolhuter, 2006).

2.6 TEACHER EDUCATION: POST-APARTHEID

The new democratic South African government of 1994 brought drastic changes to teacher education in the country. As it was known that the educational system during the apartheid regime caused much injustice, particularly to the Blacks. Under the apartheid government, the nation's teacher training was segmented by race and geography, managed by 19 different government departments, each with its own prerequisites (Jansen & Taylor, 2003; Ogunniyi & Mushayikwa, 2015).

The first black president, Dr Nelson Mandela, had a responsibility and mandate, among others, to reform the educational system that segregated the nation when he came to power in 1994. This change was inevitable because the apartheid education system did not meet the requirements of democracy and the objectives of the entire nation (Ogunniyi & Mushayikwa, 2015). According to Professor Sibusiso Bengu (The first Black Minister of Education, 1994-1999), top on the list of the government mandate was to create a truly national education and training system. The aims included the following:

- To redress the inequity experienced in the past, which benefitted the White minority schools with a well-resourced learning environment, as compared to the Black schools, which were poorly resourced;
- To change and overhaul the entire education system of the nation despite differences in race and geography and
- Finally, to widen the learning opportunities for all South Africans.

It is evident that apart from the White teachers, the teacher training for Blacks was demoted to a level of low cognitive demand, where the content knowledge of the teachers was below standard (Chisholm 2012; Jansen, 2004).

In 1994, the ruling Black government political party, the African National Congress (ANC) published the 'Yellow Book', titled 'A Policy Framework for Education and Training'. The book indicated that the ANC government had the vital responsibility to develop and implement a unitary national education system managed by a Ministry of Education and Training (Ogunniyi & Mushayikwa, 2015). As stated in policy, all the nation's higher education and training institutions, i.e., teacher colleges, universities, and Technikons, would henceforth be under the same system called the "National System of Higher Education" to ensure unity and standards across the sector (Gordon 2009). The aim was also to de-segregate and widen admission to higher education institutions for the earlier disadvantaged races.

When teacher education was moved to the higher education sector, some provinces operated teacher training colleges combined with universities. However, it is very disheartening to discover that the objective of the post-apartheid government to have a non-racial and non-segregated education system was not fully achieved, in the sense that the policy allowed the higher education institutions (HEIs) which were in charge of teacher education to retain their structure, hierarchy, and exclusivity (Kimathi & Rusznyak, 2018; Ogunniyi & Mushayikwa, 2015). Consequently, indigenous 'white' universities continued only to admit white student teachers. They devised different policies and classified selection procedures to continue to marginalise or reject other races (Ogunniyi & Mushayikwa, 2015). Therefore, it is correct to say that the democratic government of ANC could not guarantee a single education system for benchmarking qualifications, especially as the higher education institutions remained independent and autonomous in their operations. As a result, the democratic government felt that there was a need to develop a home-based system of developing standards and benchmarking for qualifications that could apply across all the institutions of higher learning (Ogunniyi & Mushayikwa, 2015).

To further expose the damages of apartheid on South African teacher education, an audit on national teacher education was carried out in 1994-1995 It was revealed that the then-existing teacher training system was disorganised, and there was no coordination with other education systems, and institutions (Hofmeyr & Hall 1996). There were worries about the curriculum programmes provided by these colleges because they were irrelevant and sub-standard. Therefore, to improve the system's efficiency, teacher training colleges had to be merged with universities and universities of technology, and Technikons were merged with universities.

Also, in 1995, the democratic government developed a National Qualifications Framework (NQF), with the main objective to provide a set of principles and guidelines by which records of student achievements are registered to enable recognition of acquired skills and knowledge, thereby using an integrated system that encourages lifelong learning (Ogunniyi & Mushayikwa, 2015; Maharajh et al., 2016).

Nonetheless, the government not only saw the NQF as a qualification synchronisation tool, but also as supporting a particular transformative purpose. This transformative purpose was reflected in the five NQF objectives as stated below:

- Create an integrated national framework for learning achievements;
- Facilitate access to and mobility and progression within education, training, and career paths;
- Enhance the quality of education and training; and
- Accelerate the redress of past unfair discrimination in education, training, and employment opportunities;
- Contribute to the full personal development of each learner and the social and economic development of the nation at large (SAQA 2000).

Thus, through further training, the NQF enabled an alternative way to acquire skills, providing hopes of economic redress for earlier disadvantaged races. Dated back to around 1994, most of the teachers from disadvantaged races were either underqualified or unqualified, and indeed, many of these teachers had no professional qualifications or had limited subject-specific training. Fortunately, through the establishment of the NQF,

underqualified and unqualified teachers could acquire the same professional skills through in-service training (Ogunniyi & Mushayikwa, 2015). Several bridging and upgrading qualifications were also devised, such as the Medium-term National Programmes, i.e., the National Professional Diploma in Education (NPDE) and Advanced Certificate in Education (ACE). These courses, were developed to give and provide teachers speedy access to Further and Higher Education and Training. Above all, the NQF was perceived as a transformation tool that provided the much-anticipated force against apartheid's effects on the nation's education system.

The National Qualifications Framework, through its multiple entry points afforded the under-qualified teachers in the field an opportunity to improve and upgrade their qualifications while practising. These alternative pathways enabled teachers to be the envisaged life-long learners by enacting one of the seven teacher roles as outlined in the norms and standards.

Ogunniyi and Mushayikwa (2015) mentioned that Keevey (2006) identified three pathways to higher education qualifications available to teachers:

a. Earning SAQA credits through in-service short courses (ACE, other SAQA accredited in-set short courses, leading to an ACE equivalent);
b. Earning credits through upgrading and bridging courses (e.g., NPDE); and
c. Formal Initial Professional Education and Training (IPET) courses (B. Ed or a first degree plus an Advanced Diploma in Education).

The South African Council of Educators (SACE), the principal body responsible for registering teachers as professionals, is entrusted with the responsibility to develop professional and competence standards that will be used to regulate the continuum of the teacher education career path (SACE, 2007). On these bases, the new National Policy Framework (NPF) on Teacher Education and Development was also endorsed by SACE. The educational pathways outlined in the (NPF) on Teacher Education and Development were hence merged and incorporated into the education policy; this incorporation, however, created a platform for Continuous Professional Development (CPTD), which emanated from the Initial Professional Education of Teachers (IPET). Teachers could

hence take responsibility for their professional and career development; the teacher training institutions, therefore, had to ensure that they are versatile and flexible enough to meet the different needs of teachers (SACE, 2007).

2.7 GOVERNMENT'S EFFORTS AND CONTRIBUTIONS TO ADDRESS INEQUALITIES IN TEACHER EDUCATION IN SOUTH AFRICA

Ever since the new democratic government of 1994, the administration has been trying its best to correct the damages created by the apartheid government. Because of this, the late Dr Nelson Mandela administration had to look into the education system. The major damage of the apartheid government to the education system is based on inequality. The post-apartheid government had to implement many policies to reform and transform the education system. As a result, there were changes in the education school curriculum. Furthermore, to mitigate the inequalities in terms of qualifications between White teachers and teachers of other races (Black, Coloured, and Indian), the government had to prioritise some policies (Ogunniyi & Mushayikwa, 2015).

One of the South African government's efforts to address teacher education inequalities was to upgrade the qualifications and competencies of practising teachers to prepare them for implementing the new policies and curriculum. Many of these teachers' upgrade programmes were designed to be offered through distance or correspondence education (DoE, 2006).

To achieve the purpose, a 2001 partnership involving the Department of Education and the Education Labour Relations Council (ELRC), offered bursaries for the National Professional Diploma in Education (NPDE), a national programme that allowed teachers to upgrade their qualifications to a minimum level (REQV 13).

In addition, the post-apartheid government recommended that teacher training colleges should be merged with universities and universities of technology, while Technikons should be merged with universities. The reason behind this initiative and policy was to ensure that all South Africa students' teachers obtained the same quality of tertiary education and qualification since they would be issued with B.Ed certificates (Ogunniyi & Mushayikwa, 2015).

An article written by Kimathi and Rusznyak (no date) pointed out that four policy frameworks have been developed to regulate and evaluate the practices of South African teachers, which include the following:

- *The Roles of the Educator and Their Associated Competences, which formed a part of the Norms and Standards for Educators (DoE, 2000);*
- *The SACE Code of Professional Ethics (SACE, 2007);*
- *The criteria for performance evaluation of teachers in the Integrated Quality Management System (ELRC, 2003); and*
- *The Basic Competences of a Beginner Teacher (DHET, 2015).*

All four policy these frameworks clearly indicated the expected conduct of teachers and the provision of procedures used to assess and reimburse teachers' work. These frameworks guide the design of pre-service teacher education curricula and the building of continuing development of in-service training for teachers.

Pursuant to promoting teacher professionalisation, this led to the establishment of a professional body for teachers called the South African Council of Educators (SACE) (DoE 2000b).

SACE was responsible for the registration of qualified teachers, and endorsement of ongoing professional development programmes. In addition, SACE was mandated to create a set of professional teaching standards for South African teachers (DoE 2006b).

Furthermore, the Integrated Strategic Planning Framework for Teacher Education and Development in South Africa 2011–2025 (DBE & DHET, 2011), one of its outlined strategic plans was a need to support the obligation and responsibility of SACE in designing and developing the knowledge and practice standards of teachers which can assist the execution, management and quality assurance of continuous professional teacher development (DBE & DHET, 2011).

In conclusion, the ELRC Collective Agreement Number 8 of 2003, indicated the purpose of an Integrated Quality Management System (IQMS) as follows:

- *Identify the needs of educators for support and development;*

- *To provide support for continued growth;*
- *Promote accountability;*
- *Monitor an institution's overall effectiveness; and,*
- *Evaluate educators' performance.*

IQMS is a combination of teachers' accountability and appraisal system designed for informed professional development. It affords teachers the opportunity of indicating where they need support and development. Subsequently, it also guides both the school and the Department of Basic Education to design interventional programs that are relevant and will best address the needs of the teachers.

This appraisal system (IQMS) resonates with the seven teacher roles as outlined in the norms and standards (2000) in that it creates a platform for teachers to take charge and accountability for their work in a continuous basis. Apart from it being a holistic self-reflection tool, it also motivates teachers to continually strive to improve their skills and qualifications to build and reinforce their career paths. The importance of positive interdependence among teachers is also encouraged by this appraisal system; for example, one of the performance standards prescribed by IQMS is that every teacher must belong to at least one professional body relevant to their scope of work. At this juncture, it is important to indicate that one of the professional bodies' major purposes is sharing good practices. The culture of teachers working in silos is hence discouraged.

In conclusion, despite all the efforts put into place by the democratic government of South Africa since 1994, South African teachers are still faced with many challenges. These problems the teachers face require not only attention and support from the government alone but also from all educational stakeholders.

2.8 SOUTH AFRICAN SCIENCE TEACHERS AND THEIR CHALLENGES

South African teachers are faced with quite a number of challenges in delivering effective curriculum content. The national government has tried in many ways to cushion the effects of some of these challenges on the education system, but very few results were yielded from all the governmental interventions.

The South African education system has undergone several curriculum changes since 1994. Many of the teachers, not limited to science teachers alone, complained about the changes in the curriculum. They mentioned challenges, which include poor training, unclear language, the multifaceted curriculum design, absence of support, and the duration of execution (Adu & Ngibe, 2014). The teachers were confused and stressed, leading to learners' underperformance in some schools.

In research conducted on teachers' experiences regarding the implementation of NCS, a teacher cited that continuous change in curriculum contributes to poor implementation of the curriculum (Adu & Ngibe, 2014). The teachers are expected to move from what they have experienced and attained and focus on the new curriculum that was brought to them. Unfortunately, they were not part of the curriculum planning or part of the decision-making, but they were the ones expected to implement its execution (Adu & Ngibe, 2014). However, most of these teachers were not skilled to implement the operation of the curriculum, in other words, they needed more training. In my view, I referred to this as 'the trainers need to be trained to train.' This was a great problem faced by the teachers, which led the government to review the curriculum to accommodate the complaints they raised.

Furthermore, even when the CAPS was introduced to cushion the challenges raised by the teachers, the curriculum still met with some resistance. CAPS was developed for each approved subject in South African schools from Grades R-12 to replace subject statements, learning programme guidelines, and subject assessment guidelines in Grades R-12 (DBE, 2011). However, CAPS was structured and designed for science subjects such that teachers should impact the scientific knowledge and understanding of their learners and engage them in science process skills (DBE, 2011). Consequently, the teachers face challenges in delivering the science curriculum effectively. These challenges ranged from lack of resources, i.e., textbooks, practical materials, overcrowded classrooms, and lack of qualified teachers (Maharaj et al., 2016). In addition, Letshwene and Du Plessis (2021) cited a lack of content knowledge among subject teachers as one of the major problems. As a science teacher, both content knowledge

and pedagogical content knowledge are vital as it boosts the teachers' confidence, as well as making them the masters of discipline.

Nicholas Spaull stated that

> *"most studies assume that teachers already have the basic content knowledge which they are expected to teach, and thus the real question is whether they can convey that knowledge to their learners or how much more they need to know?"* (Spall, 2013:24)

It was also discovered that South Africa has some of the least-knowledgeable primary school science teachers in Sub-Saharan Africa. Many of these science teachers, especially those that serve poor and rural communities, have below-basic levels of content knowledge. According to Michael Gardiner (2008), villages and rural communities are difficult to reach, the physical conditions in schools are inadequate, and learner performance compared to schools elsewhere is weak. Many rural schools lack basic infrastructure such as laboratories, computers, libraries, and running water. Lack of this infrastructure will affect the quality of science education's quality in the schools. In many instances, the teachers in such areas cannot answer questions their learners must answer according to the curriculum (McCarthy & Oliphant 2013).

The National Policy Framework for Teacher Education and Development (DBE, 2006) stated that "*many teachers*" poor conceptual and content knowledge contribute to low levels of learners' achievement. In this premise, I agreed that teachers needed to be empowered and emancipated through approved programmes or interventional activities.

Teachers teaching outside their specialisation area face extensive challenges in lesson planning and science teaching. One of these problems is insufficient knowledge of the subject. A teacher is expected to understand the structure, pattern and nature of the subject and its content knowledge, but for teachers who teach topics outside the area of their expertise, pedagogical content knowledge becomes one of the difficulties they experience (Mizzi, 2013). When teaching outside the area of their subject specialism, lessons were more teacher-dominated, the teacher devoted more time to explain, and therefore instructional activities planned were less risky from unfamiliar content. But the

opposite is true for a teacher teaching within their subject specialism, as it is more learner-centred (Mizzi, 2013). Additionally, teachers who teach outside their specialisation may be faced with a lack of confidence which can lead to an inability to teach effectively (Netshivhumbe & Mudau, 2021). From my personal experiences, I have noticed that most science teachers who teach outside their specialisation are unable to present a lesson plan, unable to select appropriate teaching material to assist learners, unable to respond to questions raised by learners, and above all, they find it very difficult to set up a practical class for learners' practical activities.

By the norm, science subjects are seen as practical subjects worldwide. This requires science teachers to include practical activities in their lesson plans and also to demonstrate the activities for the learners in their classrooms. This problem may be attributed to teachers' qualification, competency in the subject, and experience. It was discovered that many of the science teachers teaching science subjects lack enough expertise to engage the learners in practical activities. This assertion was also supported in the report of the Ministerial Committee on Rural Education (2005), which highlighted the specific challenges facing teachers in rural schools. The report noted a shortage of qualified and competent teachers, problems with teaching in multi-grade and large classes, under-resourced school facilities, and limited access to teacher professional development programmes (DoE, 2006). In addition, according to Du Plessis and Mestry (2019), some under-qualified science teachers relied only on textbooks to teach and failed to do practical investigations with their learners even when laboratories were available in their schools to demonstrate practical activities. Therefore, it is obvious that science teachers with inappropriate knowledge of the subject will affect the learners' performance.

A study conducted by Ogunniyi and Mushayikwa (2015) concluded that the most critical challenge for teacher education in South Africa was the limited conceptual knowledge of many teachers. This includes a poor grasp of their subjects as evidenced by a range of factual errors in content and concepts during lessons. Teachers' poor conceptual and content knowledge contributes to low levels of learner achievement (Department for International Development, 2011). A report by Alebous (2021) indicates that some science teachers, especially in primary schools, are hesitating to teach science because

of their limited subject matter (SMK) and pedagogical content knowledge (PCK) in the subject.

It is a known fact that many teachers teaching science subjects complain of not getting enough support. Apart from the fact some of them are not competent to teach the subject due to non-specialisation, non-mastering of the concepts, and non-fluency in the language of instruction, they are expected to deliver lessons in inclusive and diverse classrooms using integrated communication technology (OECD, 2009).

To achieve this, teachers need motivation and support because of the many challenges they face during their career. One way to motivate and support teachers is by engaging or organising effective professional teacher development. Ogunniyi and Mushayikwa (2015) corroborated this view by indicating that continuous professional teacher development (CPTD) and school-based support services will assist teachers in coping with the demands of teaching a highly innovative school curriculum in a democratic society.

2.9 PROFESSIONAL DEVELOPMENT

Professional development (PD), which is otherwise referred to as ‘capacity-building’, is an essential method of empowering staff, workers, and professionals to be more effective in the implementation of the curriculum (MacDonald, Barton, Baguley, & Hartwig, 2016; Phillips, Ingrole, Burris & Tabulda, 2017). This means that PD assists staff in acquiring knowledge to improve their work experience and professionalism.

Teachers or staff with relevant knowledge, skills, and experience in the discipline are critical for promoting the quality of curriculum delivery (Battey et al., 2016; Bell, 2015; Jess, Carse, & Keay, 2016).

A curriculum can only be executed successfully by those who have the relevant knowledge of it; this is one of the reasons why it is mandatory to apprise teachers of curriculum development activities (Battey et al., 2016; MacDonald et al., 2016; Mafora & Phorabatho, 2013). This curriculum execution can only be achieved by organising activities that can capacitate the teachers through relevant PD programmes, which serves

to develop their knowledge and skills in the delivery of the curriculum (Mafora & Phorabatho, 2013; Mohyuddin & Khalil, 2016; Vold, 2017).

Effective PD programmes or activities should be connected to classroom practices and suitable to both the teachers who implement the curriculum and their institutions. (MacDonald et al., 2016; Phillips et al., 2017).

The South African Council of Educators (SACE) have made it compulsory for all teachers in the country to undergo PD activities to improve their professional careers, since one of the main functions of SACE is to promote and facilitate the professional development of teachers. According to SACE (2013:4), "*Teachers need to continuously renew their commitment to their profession, to express their pride in its ideals of service, their dedication to our children's development and their determination to contribute to a just and thriving nation*." SACE, therefore, developed a Continuous Professional Teachers Development (CPTD) Management System to assist all teachers in getting good value from their professional development activities, whether undertaken on their own, in school, or externally. Hence, the Department of Basic Education is working with SACE in this regard since they are the employer of the teachers. However, their role is to develop and plan the CPTD Management System with advice from education specialists (SACE, 2013).

According to SACE

> *"The CPTD Management System is a new way of organising and recognising teachers' professional development, this includes:*
>
> - *What teachers do on their own to develop themselves and improve learning;*
> - *What teachers do as part of the school collective to develop themselves and improve teaching, learning, assessment and service to the community; and*
> - *What teachers do to develop themselves and improve teaching, learning, assessment and service to the community by taking*

advantage of good quality services provided by employers, unions, professional associations and others." (SACE, 2013:7)

Nonetheless, the Department of Basic Education (DBE) and other education stakeholders agreed fervently with PD for teachers, and it was suggested that the PD programmes should be continuous, not once-off. I also concur with this sentiment shared by the DBE and the other education stakeholders in the sense that if the PD programmes organised for the teachers are continuous, it will not only improve their knowledge and skills about their discipline, but it will also keep them updated with the new information and development regarding their profession or discipline.

2.10 CONTINUING PROFESSIONAL DEVELOPMENT

There are many definitions ascribed to the meaning of CPD.

According to Oxbridge Academy (2017:2) *"CPD as a term used to describe learning activities that professionals take part in to develop and enhance their skills."*

In CPD, professionals are engaged in learning activities or programmes that develop and enhance their skills and knowledge in their careers (Gomba, 2019). It is, therefore right to say that CPD is any activity or programme that aims to promote professionals' knowledge and skills through orientation, training, and support. It is an endless process coupled with training, practise and feedback, as well as suitable time and follow-up support. However, evaluation of the activities or programmes of CPD is not only required, but they are vital because they provide feedback on the achievement of the intervention; it can further assist in determining whether or not more CPD is desired (Khan, 2021).

Allen and Weaver (2014:3) defines CPD as a process "*of tracking and documenting the skills, knowledge and experience that you gain both formally and informally as you work, beyond any initial training. It's a record of what you experience, learn and then apply*."

In other words, one acquires the knowledge as one works and applies the experiences as well. This means that the knowledge and skills gained in the process of working can be termed to be continuous and lifelong. CPD not only helps one to manage their

development on an ongoing basis, but it also maintains and enhances the knowledge, skills, and experience related to one's profession (Kloosterman, 2018).

However, one can acquire knowledge and skills from designed CPD activities or programmes. CPD activities are described as all learning activities received throughout life with the objective of improving knowledge, skills and proficiencies within a personal, civic, social and/or employment-related perspective (El-Deghaidy et al., 2014). However, I agree with the blog below, which indicates the programmes or activities where teachers or staff could receive further knowledge and skills. Nonetheless, it is very important to adequately identify which programmes will be effective and relevant to science teachers to address their curriculum challenges.

Figure 2.2: Some PD programmes or activities

Source: The importance of Professional Development: S&S Blog, (2022).

Figure 2.2 represents the programmes or activities of the PD where the teachers or staff can receive their desired knowledge and skills.

Furthermore, Gomba (2019) listed CPD activities or programmes as follows: workshops, conferences, consultation, coaching, courses (which improve their qualification professionally), demonstrations and peer observation, mentoring, inductions for beginner teachers, job rotation, teamwork and group work, clustering of schools and school visits, as well as designing and executing school improvement projects, communities of practice, lesson studies, reflective supervision and technical assistance.

As it has been said above, CPD is an ongoing process of developing, maintaining, and documenting one's professional skills. Nonetheless, CPD is designed to help one identify and act on one's development needs. The pattern in Figure 2.3 below is used to design a CPD activity.

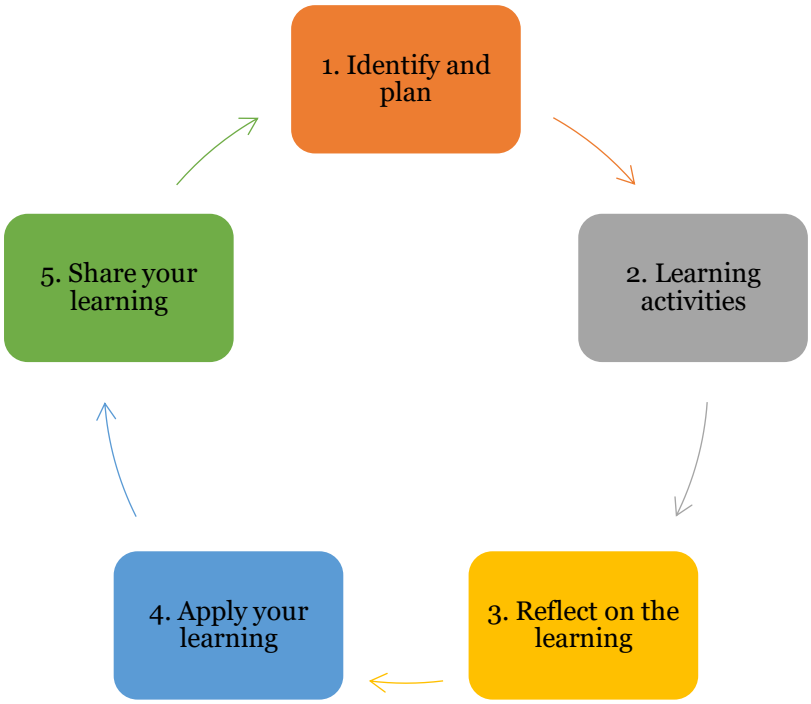

Figure 2.3: Pattern used to design a CPD activity.

Source: Continuing Professional Development, SkillsYouNeed (2017).

Figure 2.3 has five elements used to design CPD activity; they are listed below.

i. Element 1.

Identify and Plan: There are various ways of identifying development needs. For example, one can carry out a skills audit. Colleagues or professional seniors can give one feedback on areas where they are weaker, or one may have an interest in a particular area to be developed. Once this key area is identified, one needs to plan the activity (El-Deghaidy, 2014).

ii. Element 2.

Learning activity: planning of learning activities can either be formal, such as training courses or qualifications; this will depend on the identified professional area. The activities may be provided by an external provider which will attract some funding either from the employer or through raising funds. Informal learning may include side-by-side, video training, mentoring, coaching, or reading on a subject (El-Deghaidy, 2014).

iii. Element 3.

Reflection on the learning: Reflection on what you have learnt from the CPD activity is very important. Reflection on both formal and informal CPD activities enhances and influences the professional career of a person by adopting the useful aspect in the process (SkillsYouNeed, 2017).

iv. Element 4.

Apply your learning: This is a process of applying what you have learnt or acquired (skills) from the CPD activities in your job. Consequently, this will improve efficiency at work. As a matter of fact, the main reason for designing a CPD activity is basically referred to as an interventional strategy in improving and contributing to the professional development of an individual's job (SkillsYouNeed, 2017).

v. Element 5.

Sharing your learning: this is the part in the cycle where you share your experience or acquired skills with others. This is a phase where you teach others as well.

CPD is about ensuring that individuals have the opportunity to update with new trends and constantly learn to improve their subject and professional knowledge; in other words, it is a vital tool for maintaining the skills and expertise of staff (Moonasar & Underwood, 2018).

Based on these findings, teachers need continuous support and training to cope with curriculum changes that affect the educational system. However, it is established that many science teachers experience some difficulties in pedagogical content knowledge, and many of them, especially in rural areas, struggle with the language of the subject (language of science) (Spaull, 2013).

In a project conducted by the Southern and Eastern Africa Consortium for Monitoring Educational Quality III (SACMEQ III), data analysis also shows that many South African teachers, e.g., “Mathematics and Science Teachers”, have insufficient content knowledge being unable to answer the same testing questions administered to their Grade Six learners (Spaull, 2013).

One way to minimise the problems science teachers face to deliver a quality and effective educational curriculum is to support them through continuing professional development programmes. These programmes should be designed to assist the teachers’ efficacy in curriculum delivery (pedagogical content knowledge, teaching methods/strategies, process skills, evaluation, and assessment) (Uzal & Erdem, 2020).

The South African Council for Educators (SACE), a professional body registered by law, is mandated to ensure that the teaching profession is maintained and to oversee that teachers are engaged in CPD programmes. The council believes that CPD programmes will promote teachers’ knowledge of the curriculum and the subject they teach, including enhancing their instructional skills (SACE, 2008).

2.11 CONTINUING PROFESSIONAL DEVELOPMENT FOR TEACHERS

In recent years, CPD for teachers has received considerable attention in many countries worldwide to boost professionalism in the field of work, including the low-income countries (Nudzor, 2021).

CPD for teachers can be described as planned lifelong activities or programmes for advancing and improving teachers' individual skills, capability, understanding and knowledge, which develop both themselves, the learners and the schools (Khan, 2021).

According to OECD, CPD for teachers include the following characteristics:

- *"To improve individual's knowledge on the subject.*
- *To improve individual's skills, attitudes and approaches in light of development in the new teaching techniques, objectives, and new educational study.*
- *To allow individuals, apply and make changes to curricula.*
- *To enable schools, develop and implement new strategies regarding the curriculum and other parts of teaching exercise.*
- *To exchange information and expertise among teachers and others.*
- *To assist weaker teachers become more effective."* (OECD, 2009: 49)

It should be noted that CPD is not peculiar only to the South African milieu. It has been discovered that different countries use different policies on CPD for teachers, depending on their context (Gomba, 2019).

Guldenhuys and Oosthuizen (2015) group the CPD of teachers into different categories based on their settings and purpose. In the first category, CPD activities are developed to renew licenses and career development or salary benefits and can be optional or not. This practice can be found in countries like Germany, the United Kingdom, Poland, Portugal, Slovakia, Slovania, and Spain. According to Guldenhuys & Oosthuizen (2015), countries like France, Greece, Iceland, etc., perceived CPD as a professional responsibility, but participation is optional. This practice also applies to South Africa, where CPD is an obligation to teachers, but teachers are given various activity selection opportunities to participate. They accumulate points for participating in various CPD activities (Guldenhuys & Oosthuizen, 2015).

The second category is where CPD activities can be initiated by the authorities. This type of style is seen in countries such as Australia, America, and Japan, even though this style

failed because the intended objectives were not achieved. This also applies to South Africa in the sense that some professional development was not approved, recognised or imposed on teachers (Guldenhuys & Oosthuizen, 2015).

The last CPD activity category occurred in a country such as the Netherlands. CPD was introduced for their teachers due to the changes in their curriculum. This change occurred when the Dutch central government granted the country's secondary schools' autonomy to reform their curriculum and teaching methods. The reform is aimed at making educational programmes more competence-based. As a result, it is very difficult for the teachers to move into a new role and tasks associated with competence-based education, i.e., from an expert into a coaching role. (Seezink & Poell, 2010).

South Africa as a country can be classified into the last category of CPD style, in the sense that the country also engaged in curriculum reforms. The teachers experienced several challenges after the introduction of Curriculum 2005, which was outcomes-based (Gomba, 2019). The transition from the teacher-centred curriculum, which is content-based, to becoming a facilitator of learning in a learner-centred curriculum created a lot of confusion and frustration for many practising teachers. This, however, necessitated the intensified and sustainable teacher development programmes and support for teachers by the Department of Basic Education on continuous bases. To date, teachers in South Africa are being exposed to CPD). The CPD is the platform which teachers are expected to use to improve their professional skills, expertise as well as competencies. It is the avenue in which teachers are afforded the opportunity to set and plan their own career path goals and work towards the achievement of their own job satisfaction and growth.

When we talk about CPD for teachers, we do think of formal training alone, but CPD can include a variety of activities such as traditional activities (e.g., workshops, conferences, and courses), reformed activities (e.g., mentors and coaches) and paired professional development (e.g. team teaching and peer observation) (El- Deghaidy, 2014). I will look at different types of CPD methods that can be adopted to assist teachers. CPD activities for teachers can be classified into formal and less formal categories (OECD, 2009 & OECD, 2020). These include the following:

i. **Formal activities**

- Courses/workshops *(e.g., on the subject matter or methods and/or other education-related topics);*
- Education conferences or seminars *(at which teachers and/or researchers present their research results and discuss education problems);*
- Qualification programme *(e.g. a degree programme);*
- Observation visits to other schools *(e.g., subject advisors or curriculum advisors' visits to schools to support subject teachers);*
- Professional development network *(e.g., participation in a network of teachers formed specifically for the professional development of teachers);*
- Individual or collaborative research *(e.g., on a topic of professional interest);* and
- Mentoring and/ or peer observation and coaching *(as part of a formal school arrangement).*

ii. **Less formal activities**

- Reading professional literature *(e.g., journals, evidence-based papers, thesis papers);* and
- Engaging in informal dialogue with peers *(on how to improve teaching).*

El-Deghaidy, at el. (2014) classified CPD activities into three categories, namely, traditional activities, reformed activities, and pair professional activities, and thus explain each as follows:

- Traditional activities (e.g., workshops, conferences, and courses). Although workshops are mostly used in professional development, this model has been widely criticised as well, because it isolates the contextual information, and do not resonate with teachers' desired needs. Furthermore, it does not provide teachers with sufficient time and content to improve their knowledge.
- The reformed activities (i.e., mentors and coaches) help teachers to connect to classroom teaching and are sustained for a longer time because the activities take place in school. It accommodates and responds to their needs

and goals, thereby promoting a positive effect in upgrading their classroom practice, and

- Pair professional activities (e.g., collaborative research/action research) where two teachers work together, concentrating on a specific topic of mutual interest and benefit to both.

Moreover, Christa Philander (2018) promotes the same view as El- Deghaidy et al. (2014) in categorising CPD activities. In her research study she cited Aileen Kennedy, who grouped the CPD activities into three categories, though she termed the activities as 'Models.' The categories are: transmission, transitional, and transformative CPD. These categories are illustrated in Figure 2.4.

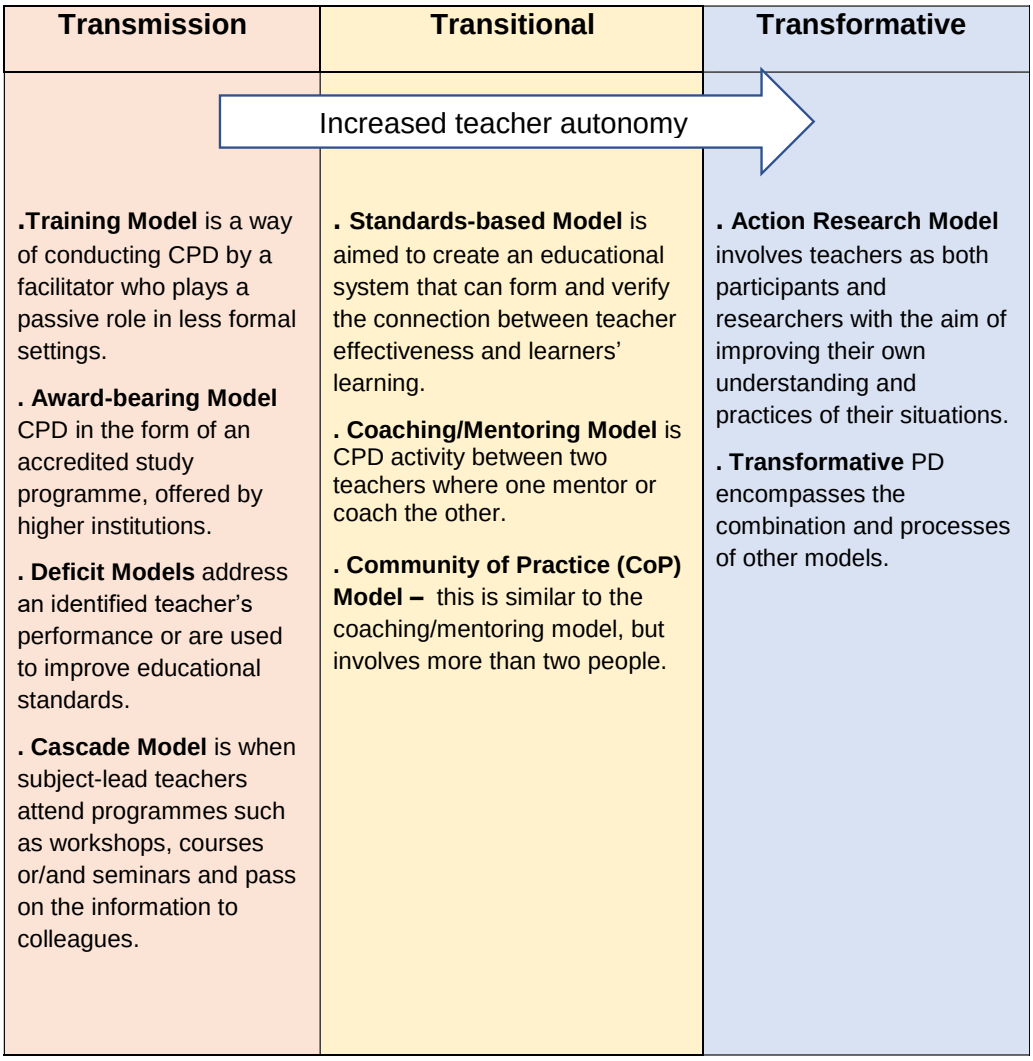

Figure 2.4: Different CPD Activities/ Models
Source: Christa Joline Philander (2018)

As illustrated in Figure 2.4, teachers gain more autonomy in their CPD practices by moving from the transmission model, otherwise known as traditional activity, into the models or activities that foster teacher collaboration, i.e., transitional and transformative models respectively. This assertion is supported by De Jong, Meirink, and Admiraal (2019), who revealed that teacher collaboration during CPD activities improved teaching and learning.

However, CPD have motivated and contributed to teachers' professional careers. Khan (2021) reviewed the result of research on teachers who were put through collaborative CPD. He found that teachers' confidence increased, they were open to new ideas and changing practices, their self-efficacy improved, and they developed more enthusiasm for collaborative work.

Rose and Reynolds (2014) have indicated that teachers have benefited from successful CPD activities, which resulted in the development of reflective and critical practice and an enquiry-based approach to pedagogy, development of practitioner dialogue, development of problem-solving skills regarding teaching practice, increased links, collaboration and cooperation with other teachers with modelling and sharing of best practice, opportunities for promotion, and personal satisfaction.

Furthermore, there is evidence that the CPD of teachers has improved learners' performance. In a study conducted by Darling-Hammond, Hyler and Gardner (2017) wherein they investigated the relationship between teachers' PD and teaching practice on learners' outcomes, it was revealed that teachers who received CPD training are using the knowledge and skills acquired to advance their teaching practice which largely affects their learners' achievement. In addition, teachers' CPD programmes or activities have contributed positively to enhancing knowledge, skills and improving their classrooms (Abdullah, Shamsuddin, Wahab & Muazu, 2018).

An effective CPD of teachers will contribute to learners' achievement, whatever knowledge and skills the teachers acquired during the CPD process they will use in classroom practice; consequently, it will contribute to learners' achievement. Teachers themselves have complained many times about the lack of support regarding curriculum delivery which can influence their classroom practice.

Figure 2.5 illustrates the benefit of CPD activities on teachers. For example, teachers are expected to possess knowledge and skills in professional standards, curricula, accountability, and assessment. Nonetheless, when the teachers are supported through CPD activities, they acquire more knowledge and skills, improving their classroom practices (teaching and learning). Above all, since the teachers' classroom practices

improved through the knowledge and skills they acquired from CPD activities or programmes, it automatically affects their learners' achievement.

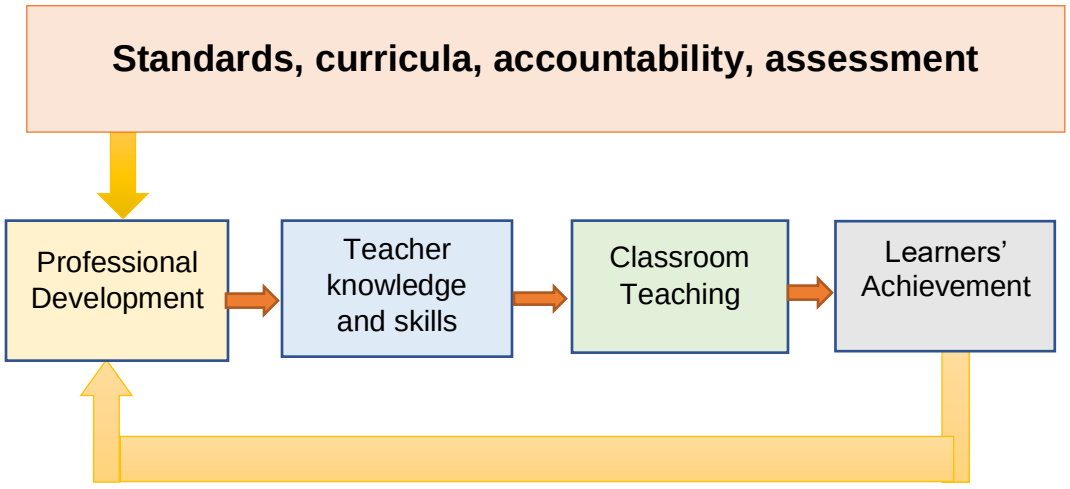

Figure 2.5: How Professional Development affects learners' achievement
Source: Reviewing the evidence on how teacher professional development affects learner achievement (Yoon, Duncan, Yu Lee, Scarloss & Shapley, 2007)

Although, it's easier to assess the impact of CPD on teachers than on learners. CPD cannot be used to measure learners' performance because its evaluations are more often subjective. CPD can be evaluated better through teaching rather than learning (Borg, Clifford & Htut, 2018). But, in my view, we can observe the effect of a successful CPD on the learners. The reason is that the teacher will display the knowledge and skills acquired from CPD activities in their classrooms. Therefore, this will have an impact not only on the learners but also on the teaching and learning process.

Despite the benefits of teachers' CPD programmes, there are several barriers faced in its implementation (Rose & Reynolds, 2014). These include:

- *Allocated time for CPD activities:* Teachers may not feel comfortable to extends their time period beyond the stipulated school day and year for any CPD activities; they prefer a day workshop instead.
- *The content of professional development:* There might be resistance from teachers who do not want to share their knowledge and skills with other

colleagues and supervisors if the CPD focuses on subject matter content and classroom practice.

- *School factors*: It is difficult to incorporate multiple characteristics when designing CPD activities in a school setting. The CPD designers must take into cognisance these characteristics, such as the time factor, when planning the activities.
- *Cost:* It is costly to design and plan for some CPD activities.

Apart from the factors mentioned above that can hinder the implementation of CPD programmes, Khan (2021) summarised and listed the different challenges that can affect the execution of CPD activities. These factors are: poor or lack of planning, insufficient funds, lack of support for schools or institutions, lack of teachers' interest, lack of unequivocal relationship between CPD and other existing developmental programmes, poor ICT skills, and poor skills in the English language.

The South African Department of Basic Education also cited some causes that limits CPD programme implementation. They include limited access to quality CPD opportunities for teachers, organising CPD activities in isolation, one-time training, lack of a coherent strategy, and lack of monitoring and follow-up (DBE, 2015).

Above all, despite all the above-mentioned factors which may affect the implementation of CPD programmes or activities, CPD has been seen to be a productive paradigm in improving, supporting, enhancing, and motivating teachers in their professional practice.

2.12 SCIENCE TEACHERS' VIEWS REGARDING CONTINUING PROFESSIONAL DEVELOPMENT PROGRAMMES

CPD programmes have been reported to be an effective tool in assisting teachers to be more productive professionally. Despite that fact, many teachers, especially science teachers, have many concerns about the nature of the CPD programmes they were offered. El-Deghaidy et al. (2014) indicate that teachers' description of CPD showed they were passive recipients of pre-packed programmes. In other words, science teachers felt that most of the CPD programmes designed and presented offered far less than their

expectations. The teachers believed that they ought to be consulted before any CPD programmes are designed, so they can suggest relevant activities that meet their needs. At this junction, I also concur with the sentiment shared by the teachers in the sense that for them to be seen as mediators and agents of change, CPD programmes must be designed and presented in such a way that it will enable teachers to transform their classroom practices to accommodate curriculum changes.

In addition, teachers insisted that according to their experiences, the most effective CPD programmes are self-initiated, including professional discussion, peer observation, and informal networking (El-Deghaidy et al., 2014). This viewpoint further explains why teachers want to be carried along before any CPD programmes are planned or designed for them. The teachers want to have a say and input on the design especially on the type of CPD activities that are relevant to their needs.

Science teachers in Saudia Arabia indicated that they encountered CPD programmes that were only content-based and did not address professional or scientific needs (Mansour, Alshamrani, Aldahmash & Alqudah, 2013). In addition, it was also discovered that there are times when the CPD providers delivered contents that did not meet the learning needs of the science teachers who were in attendance for the programmes (El-Deghaidy et al., 2014). The consequence of this will not only discourage the teachers from attending such programmes but even if they attend, they will not gain anything meaningful which will contribute to their professional growth and career. This is also attributed to one of the problems of CPD programmes that are ready-made as compared to those based on the needs (El-Deghaidy et al., 2014).

However, apart from some of the shortcomings experienced in the designing and execution of CPD programmes as reported by some teachers, CPD programmes are still regarded as the most effective tool for assisting and supporting science teachers in the acquisition of skills and knowledge for their professional career. For example, Heredia and Tan (2021) emphasise the need for CPD programmes for science teachers. Based on her research study exploring the role of coherence in science teachers' sense-making of science-specific formative assessment in professional development, the science

teachers indicated that with the intervention of CPD activities, their ability to set the science-specific formative assessment tasks improved. The teachers were used to set formative assessment tasks that were just science content based without infusing science process skills; however, with the intervention of CPD activities, the teachers became aware and also knew how and what to include in their formative assessment tasks for the learners in their science classrooms.

Furthermore, a research study conducted by Saeed Almuntasheri (2020: 10) titled "*The impact of professional development on dialogic teaching for science teachers in Saudi Arabia*" investigated strategies that supported the implementation of dialogic teaching in science-based inquiry classrooms. Almuntasheri discovered that science teachers lack sufficient skills to interact with their learners in science-based inquiry settings. In addition, he found that science teachers are frequently faced with difficulties in putting across the type of classroom dialogue required by inquiry instruction because teachers mostly dominate the classroom conversation while the learners do little in the discussions. However, after the intervention of a designed CPD programme organised for the science teachers, the results showed that the participating teachers improved in their use of strategies that encourage inquiry teaching, which promote learners' participation in discussions. Additionally, the reported result embraced the call by the science teachers for CPD programmes because it could be seen that the programmes enhanced and supported the teachers to initiate a dialogic inquiry approach. The participating teachers developed more dialogic conversations that supported better learner engagement (Almuntasheri, 2020).

Thus, science teachers' views regarding CPD programmes or activities can be summarised into two categories. The first category of teachers said they prefer to be carried along before any CPD programmes are designed for them. In addition, they indicated that some of the programmes are not of much benefit to them because they do not include their needs and so cannot positively affect their professional career and transform their classroom practices. The teachers do not just want a ready-made CPD programme forced on them without consulting them to know their needs. The second category of teachers vehemently embraces CPD programmes without any form of

protestation or discontentment. They are just happy with the programmes because they experienced tremendous improvement and benefit from it in their professional career, which positively influences their classroom practices.

The plight of the first category of teachers was also echoed by South African Department of Basic Education, who shared the same sentiments. The Department places importance on CPD for teachers but has found that most of the CPD programmes for teachers did not meet their needs, especially with the constant curriculum reforms in the country (DBE, 2015). Mrs A. Motshekga (Minister of Basic Education) and Dr B. Nzimande (Minister of Higher Education and Training) launched what is known as 'Integrated Strategic Planning Framework for Teacher Education and Development 2011-2025' (ISPFTED) to address these challenges and strengthen the progress of CPD programmes. The ISPFTED, therefore, proposed the establishment of Professional Learning Communities (PLCs) to strengthen teacher professionalism and promote collective participation in professional activities for professional development (DBoE, 2015). In a PLC, classroom teachers, school managers, and subject advisors must collectively determine their professional development needs (DBE, 2021). In this way, teachers are involved in planning CPD programmes and do not just receive ready-made CPD programmes forced on them without consulting them.

2.13 THE IMPACT OF CONTINUING PROFESSIONAL DEVELOPMENT ON CURRICULUM IMPLEMENTATION

CPD programmes impact on curriculum implementation, although the execution of the programmes are faced with different challenges which vary from country to country (Khan, 2021). Research has confirmed that progressive changes happen in teachers' professional careers when they experience effective CPD programmes.

Gore, Lloyd, Smith, Bowe, Ellis and Lubans (2017) revealed in a study that CPD positively impacted teaching quality while the teachers followed a pedagogy-based and collaborative PD approach in teaching. Nonetheless, the study did not explain the details of the approach which the teachers followed, as well as the challenges in the implementation of the specific approach.

Borg et al. (2018) measured the impact of CPD on 1 647 pre-service teachers and educators in Myanmar which were based on the teachers' knowledge regarding teaching methods, teaching skills, reflective ability, and professional confidence. Even though the study results showed a positive impact on teachers' CPD, it was inconclusive due to some limitations. For example, the research was conducted with 85.1% female respondents and did not explore the male teachers' knowledge and skills enough.

In research conducted by Saeed Almuntasheri (2020), it was found that Teachers' Professional programmes are considered an effective tool for enhancing the quality of learners' explanations of science, and the teachers were better able to develop a higher discourse when they were trained to use different strategies to challenge and scaffold learners' thinking. Furthermore, the report from the National Survey of Science and Mathematics education argues that there are improvements in the outcomes of high school secondary science teachers who received a notable amount of PD from external sources to their school due to reforms in science education (Banilower, Smith, Malzahn, Plumley, Gordon & Hayes, 2018). It can therefore be concluded that CPD programmes for teachers is a vital tool for improving classroom instruction and learner achievement.

Darling-Hammond (2017) showed a very positive relation between teachers' PD, teaching practices, and students' outcomes. The study was conducted only on secondary literature and did not experiment on a sample. In this kind of study, the results may be strengthened and more representative if both data types are analysed.

In a nutshell, some teachers see CPD programmes as extremely helpful in increasing their professionalism, especially in curriculum delivery (Shah, Khan, & Ahmed, 2015). These teachers indicated the positive impacts of CPD. However, some teachers reported their concerns regarding CPD programmes, complaining about the structure and design of the CPD programme. According to them, the designed programmes do not assist them in improving their classroom practice because they were not self-initiated (El-Deghaidy et al., 2014).

It's obvious and essential that teachers must be supported and motivated to deliver an effective curriculum amidst the challenges they face, and the best way is to engage the

teachers in CPD activities or programmes. Therefore, for CPD programmes to have greatest impact on the curriculum delivery or classroom practice experience of teachers, the programmes or activities must be designed, implemented, and evaluated to address their needs (Almuntasheri, 2020). For example, Almazroa and Alorini (2012) argued that Saudi Arabian teachers were not able to cope with the changes to the new curriculum due to the lack of proper of professional development provided or designed for them because the CPD programmes do not meet the needs of the teachers to bring in the desired objectives.

It is, therefore, important to consider the needs of the teachers before any CPD programmes are designed for them, otherwise, it will not yield any positive or desired outcomes.

2.14 CHAPTER SUMMARY

The literature review of the international overview of education system was briefly discussed. The curriculum implementation and reforms were looked into as well. The South African education system pre- and post-apartheid were both deliberated on. This deliberation led to discussions on teacher education during the pre- and post-apartheid eras. The government's efforts and contributions to address inequalities in teacher's education in South Africa were summarily presented. In efforts to address inequalities in teacher's education in South Africa, it was discovered that South African science teachers -face some challenges. These challenges were also discussed. CPD and science teachers' views regarding CPD programmes were also exhaustively reviewed, citing some examples. Finally, factors affecting the implementation of CPD programmes together with the impacts of CPD were summarily discussed.

CHAPTER 3

THEORETICAL AND CONCEPTUAL FRAMEWORKS

3.1 INTRODUCTION

The purpose of this chapter is to provide details of the chosen theoretical and conceptual framework of the study. I looked for the most appropriate learning theory to underpin this research study. After consideration, I chose the social constructivist theory based on the work of Vygotsky as the learning theory for this study. The literature study provided an overall conceptual framework which included concepts such as curriculum, curriculum delivery, science teachers and CPD programmes.

3.2 THEORETICAL FRAMEWORK

Theoretical framework is a summary of theory or theories regarding a particular problem that is developed through a review of previously tested knowledge of themes involved (Statistics solutions, 2023). It identifies a plan for investigation and interpretation of the findings. A theoretical framework provides a foundation for the interpretation of the empirical findings of the study, and supports the rationale of the study, problem statement, purpose, and the research questions (Grant & Osanloo, 2014).

The main purpose of the theoretical framework of this study is to guide the interpretation of the empirical research to explore and improve the curriculum implementation of Grade 10 science teachers through a CPD programme. Figure 3.1 illustrates and explains the purpose of theory in research.

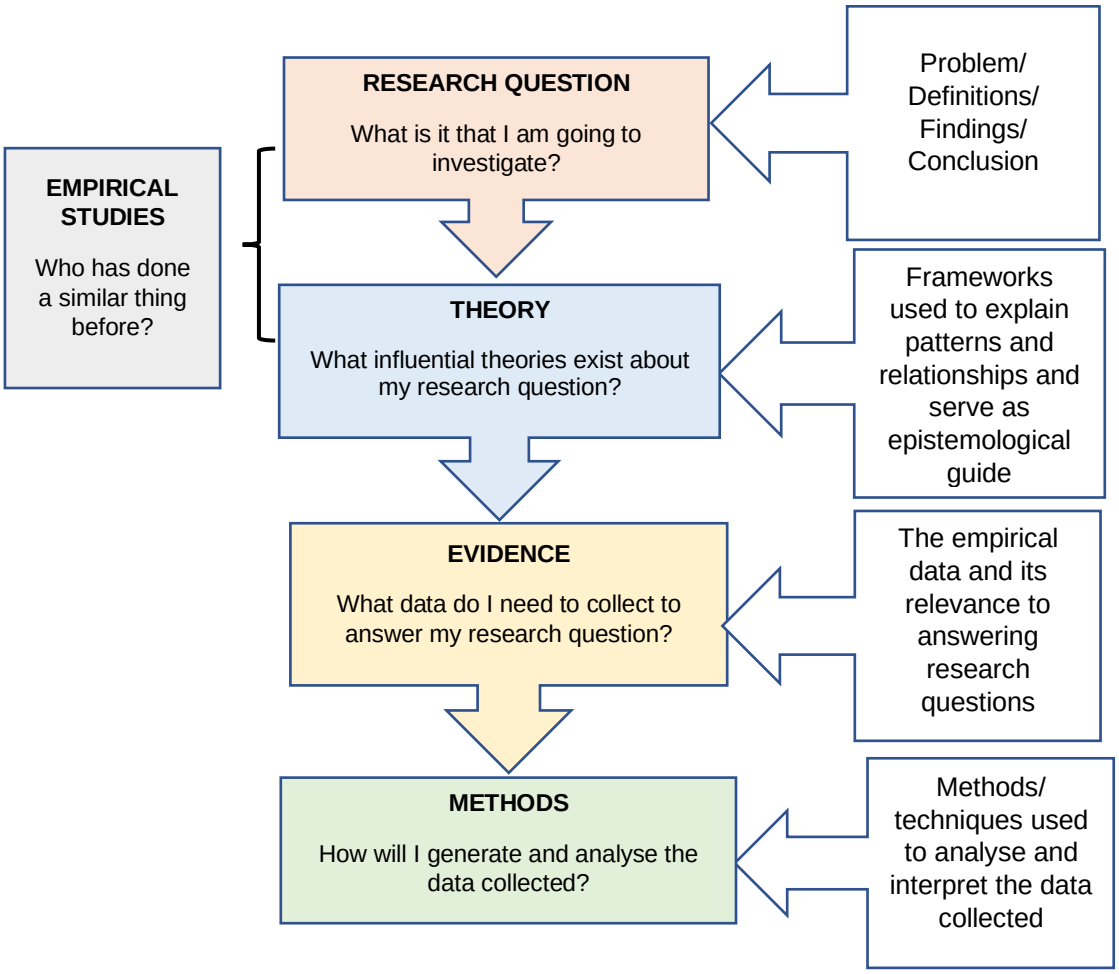

Figure 3.1: Purpose of theory in the research paradigm

Figure 3.1 elaborates and explains the research process beginning with identifying research questions. A framework is always chosen with reference to the research questions. The literature is reviewed together with empirical research that supports the choice of the theory that guided the study.

Merriam and Tisdell (2016:85) define a theoretical framework as "*the underlying structure, the scaffolding or frame of your study*." However, Ravitch and Riggan (2017) required that the theoretical framework be founded on published, identified theories. In addition, Ravitch and Riggan (2017) mentioned the 'identified theories' as follows:

I. Identify the theory cluster. This combines theories into categories, such as theories of learning.

II. Identify specific theories relevant to that cluster. This includes the originator or source and the major propositions and or hypotheses of each theory.

III. Identify the theory selected for the study. In this case, it specifies a specific theory within the cluster that will be used, the propositions of the theory that relate to the specific study, and the review of prior studies using that theory as a focus.

IV. State how the study will contribute to the body of knowledge related to the theory.

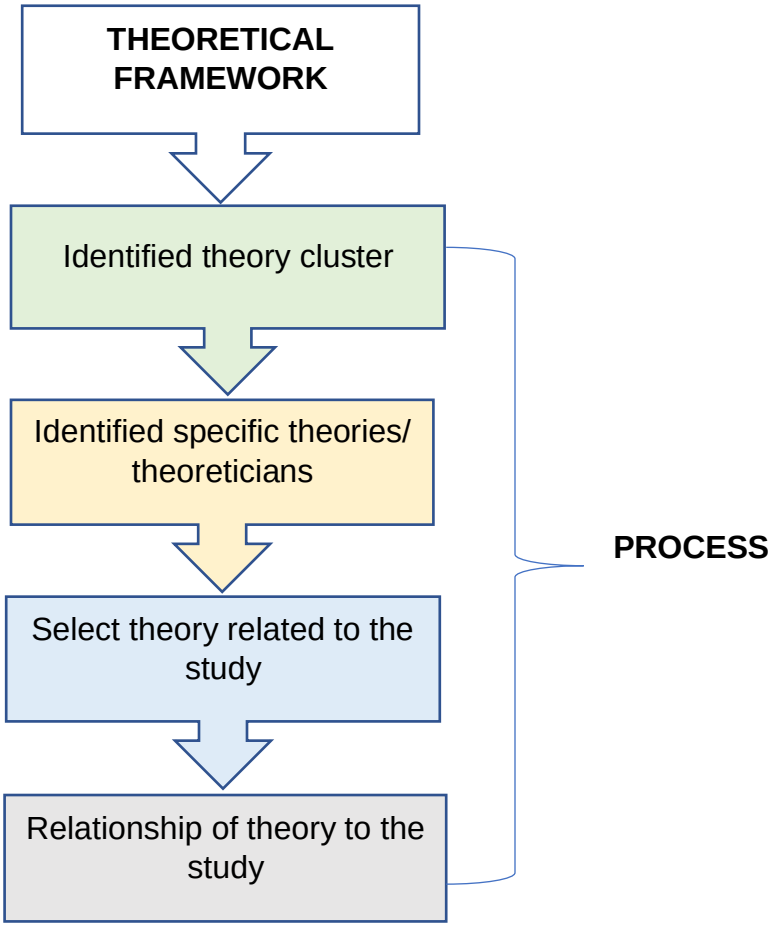

Figure 3.2: The process of a theoretical framework as it relates to a study.

In a nutshell, the theoretical framework applied to this study is identified under the constructivist theory of learning, and the main focus will be on social constructivism or socio-constructivism.

3.2.1 Constructivist theory of learning

The constructivist theory of learning is founded on the research of Piaget, Vygotsky, Feuerstein, Dewey and Bruner (Gravett, de Beer & Du Plessis, 2018).

Piaget was considered as the father of the constructivist school in the 20th century, and constructivism is a learning theory that attempts to explain how humans learn by constructing their own meanings of the world around us through the use of authentic activities (Fritcher, 2008).

There are existing thoughts around the constructivist paradigm, i.e., personal constructivism and social or sociocultural constructivism (Tobin & Tippins, 1993; Von Glasersfeld, 1995). Nonetheless, the major difference between them is the position in which knowledge construction happens.

Personal constructivists argue that knowledge is constructed in the learner's mind while re-organising their cognitive structures and experiences (Piaget, 1970; Von Glasersfeld, 1989). On the other hand, social constructivists see knowledge construction happening in communities of practice through social interaction (Kuhn, 1996; Lave & Wenger, 1991; Martin, 2006; Vygotsky, 1978).

Many researchers have successfully used constructivist theory in their studies, especially in a research study when teachers are involved in professional development activities; for example, Rout and Behera (2014), in their research document titled Constructivist Approach in Teacher Professional Development: An Overview. The purpose of the research work is to review the rethinking of teacher professional development within a constructivist framework. That is, teacher professional development should shift from a behaviouristic towards a constructivist approach. Yvonne Fung also contributed to the use of constructivist theory in her article, where she reported on a small-scale case study in which a constructivist approach was used to prepare four teachers of the same class

level in a primary school subject (Fung, 2000). The results indicated that most teachers responded positively to the constructivist approach used in the study; hence, they gained professional, personal and social development through participating in the project.

3.2.2 Constructivism

John Dewey (1933-1998) is referred to as the philosophical founder of this approach, while both Bruner (1990) and Piaget (1972) are named as the main theorists amid cognitive constructivists; Vygotsky (1978) is the foremost theorist amongst the social constructivists (Khan, 2019).

The philosophy of constructivism has spread all over the world, it became especially more popular amongst the education fraternity. Constructivism is the best method used in teaching and learning research despite its vague concept (Powell & Kalina, 2009).

Bada (2015:60) defines constructivism as "*an approach to teaching and learning based on the premise that cognition (learning) is the result of mental construction."* One can say that constructivism is the study of learning, about how we view the world and perceive reality.

Khan (2019) regarded constructivism as an epistemological view of learning rather than teaching; it is about how somebody learns by actively and consciously building on their previous knowledge and understanding to interpret and negotiate the meaning of new information or knowledge. In other words, the learners' previous knowledge and energetic participation in solving problems and thinking critically all contribute to the construction of new knowledge. One of the objectives of constructivism is to develop learners' skill in thinking critically, and this can be done successfully in a conducive environment, i.e. classroom.

Dada (2015) explains that constructivism is a theory based on observation and scientific study about how individuals learn. In addition, he said that constructivism is entrenched in philosophy, psychology, sociology and education.

Sanjna (2015) describes the four principles on which constructivism was based. These include the following:

- *Learning depends on what individuals already know.*
- *New ideas occur as old ideas are adapted and/or changed.*
- *Learning involves the development of ideas rather than mechanically accumulating facts; and*
- *Meaningful learning occurs through previous experiences.*

Constructivism believes that skills and knowledge grow in a condition where the learners have reasonable experiences. This view means that learning occurs when a person develops inner cognitive structures or when one interprets their personal experience that it's subject to change as new situations are encountered. However, because knowledge is central to learning, it becomes necessary that teachers should identify and correct any foreseen misconceptions at the beginning of each lesson. Most of the time, learners come to the classroom with misconceptions about certain ideas. If not identified and corrected by the teacher at the beginning of the lesson, these misconceptions can compromise effective teaching and learning (Wirth & Perkins, 2008).

3.2.3 Social constructivism

According to Behera (2014), Lev Vygotsky developed social constructivism, stating that learning cannot be separated from its social context, and that learning occurs within the Zone of Proximal Development. He further ascertains that the Zone of Proximal Development (ZPD) is referred to the gap between what a given learner can achieve alone, in other words, their 'potential development as determined by independent problem solving', and what they can achieve 'through problem-solving under guidance or in collaboration with capable peers' (Wood & Wood, 1996 as cited in Kristinsdottir, 2001). In summary, full development during the ZPD depends upon full social interaction, and the more a learner takes advantage of a teacher's assistance, the wider their "Zone of Proximal development" is (Kristinsdottir, 2001).

Vygotsky believed social interaction was an integral part of learning. Social constructivism is founded on learners' social interaction in the classroom and a personal thinking process (Powell & Kalina, 2009). Vygotsky proposes that learning is a collaboration between teacher and learners, with the teacher taking on an authoritative role similar to that of an expert supporting an apprentice (Behera, 2014).

Knapp defines social constructivism as a process whereby

> *each person's constructed knowledge is unique, social groups of people also hold much knowledge in common; knowledge is constructed through social interactions within specific social and societal contexts, impacted by a myriad of factors, including gender and power relationships, and mediated by the tools of knowledge of the multiple cultures to which one belongs. (Knapp, 2019:87)*

According to Taylor (2018), social constructivism is a theory about the development of knowledge through individuals' interactions. It affirms that truth is constructed by social processes and that it is historically and culturally specific. Truth depends on the human view and social experience, as it looks at the learning that a person gains from an interaction process (Taylor, 2018).

In social constructivism, the learning process is built on existing knowledge, whereby a person can interpret the existing knowledge in new forms. Knowledge is recognised as a result of human interaction and is not something to be discovered because it's a product of interactions between people within the environment (Schunk, 2012).

Mascolol and Fisher (2005) say social constructivism relies on the following fundamental characteristics which include:

a. The emphasis is on the collaborative nature of learning and the importance of culture and social context.
b. All cognitive functions are believed to originate and are explained as products of social interactions.

c. Learning is more than the assimilation of new knowledge by learners; it is the process by which learners are integrated into a knowledge community.

Above all, social constructivism is the most effective teaching method which can benefit all learners because collaboration and interaction are combined (Powell & Kalina, 2009).

3.2.4 Constructivism in a science classroom

The constructivist sees knowledge as being constructed in a social context and taking place in a socially active environment. Learning in a science classroom depends on sharing knowledge and skills with fellow learners, as well as with the teacher. The teacher serves as a facilitator or guide to help the learners since they cannot construct understanding alone; hence, they have to do it collaboratively or cooperatively through interactions (Khan, 2019). In a science classroom, learners are highly interested in exploring and using hands-on experience to solve problems. Therefore, thinking about a problem is an important part of constructivist learning because the learner's understanding becomes clear and formidable if such a learner thinks about the problem, but only he can monitor his own thinking. The teacher must provide a conducive environment in the classroom for the learners so that they are motivated to think deeply and arrive at their own conclusion. The teacher thus assists the learners to become an effective thinker, whereby they will come up with their own answers or ideas and compare it with the teacher and their fellow learners' ideas and answers. Thus, both the teacher and the learners learn from each other to construct new knowledge (Khan, 2019).

3.3 THEORETICAL FRAMEWORK THAT UNDERPINS THIS RESEARCH STUDY

Regarding this research study, the key theoretical framework is centred on the socio-constructivist theory of learning.

As said earlier, social constructivism or socio-constructivist theory of learning was founded by Lev Vygotsky (1978), who believed that knowledge is built in a social context when learning occurs through interaction with others in their environment (El-Deghaidy et al., 2014). The socio-constructivist theory of learning deals with expanding and improving knowledge when individuals interact and collaborate in an environment (Taylor, 2018).

The justification for selecting this theory is based on the fact that the Grade 10 science teachers teaching Life sciences will be improving their knowledge and skills when engaged in CPD activities as an intervention in a workshop organised by me in a particular place. It was expected that at the end of the CPD programme intervention, the teachers should have produced their own teaching plans and curriculum materials through a constructivist approach. In addition, the teachers will further benefit by developing knowledge when they interact and work with other colleagues during the CPD programmes in the workshop. In this context, science teachers can therefore be considered learners emphasising previous knowledge, skills and beliefs, feedback opportunities, revision and success, and interaction with others (El-Deghaidy et al., 2014). However, in the workshop, I acted as a facilitator and mentor. The aim was to assist the Grade 10 science teachers teaching Life sciences to develop a new understanding of teaching and learning. Thus, the teachers interacted and collaborated by working together as they formed communities of practice during the workshop, wherein they shared knowledge and skills.

The CPD programme, which was prepared for the teachers as a process of changes, would help the teachers to explore their existing understandings, perceptions and practice, and it would also provide them with the chance to construct new ideas and examine the competences of their own construct (Fung, 2006).

With the socio-constructivist theory of learning, the teachers will cognitively engage in the construction of knowledge through social means and active involvement that change teachers' classroom practice; however, the change result comes from constructing knowledge in a supportive social context which provides time for reflection and revision (El-Deghaidy et al., 2014), in this case, the social context for the science teachers is the workshop environment where the CPD programmes will take place.

The socio-constructivist approach to professional development allows teachers to construct their own knowledge in a helpful and conducive environment, thereby empowering them to be self-governing learners. Therefore, professional development

activities should provide a pathway for teachers to interpret and reflect on their learning and teaching, construct alternative meanings, and expand their views (Fung, 2006).

According to Fung the socio-constructivist approach to CPD programmes for science teachers to improve their curriculum implementation can overall be classified into the following four phases:

i. “Elicitation

This is to help the teachers to become aware of their current practices and is important because the constructivist or socio-constructivist view of learning acknowledges the impact of prior knowledge and experience in constructing new knowledge.

This is the reason why it is important for Grade 10 science teachers teaching Life sciences to undergo CPD programmes to gain more knowledge and experiences so that they can improve their curriculum implementation.

ii. Confrontation

This is to allow teachers to visualise the inadequacies of their current practice in meeting the demands of a new teaching subject or a curriculum change.

Due to the curriculum changes experienced by the science teachers in South Africa. Therefore, the Grade 10 science teachers teaching Life sciences needs to be assisted through designed CPD programmes so that they can deliver an effective curriculum in their respective classrooms.

iii. Exploration

This involves teachers constructing new teaching approaches, with challenges and advice from the researcher where necessary through the

workshop organised by the researcher who put in designed CPD programmes.

During the organised intervention workshop aimed to support the Grade 10 science teachers. The teachers were expected to work together collaboratively in a particular environment and share their experiences and knowledge with one another wherein I served as a facilitator and mentor to them. Consequently, the science teachers would acquire new knowledge, skills and experiences during the interventional CPD workshop.

iv. Application

This is a phase where the teachers test the appropriateness and applicability of what they have constructed and developed during exploration phase" (Fung, 2006:156-157).

The science teachers would use the new knowledge, skills and experiences they acquired during the CPD interventional workshop in their classroom lesson presentations to ascertain the effectiveness of CPD programme.

In conclusion, the above procedure explains how the socio-constructivist theory of learning is used in this study and why it is used since it will inform the conceptual framework.

3.4 CONCEPTUAL FRAMEWORK

Ravitch and Riggan (2017:5) define a conceptual framework as "*an argument about why the topic one wishes to study matters and why the means proposed to study it are appropriate and rigorous*.".

However, there are other authors with different views and explanations regarding the definition of a conceptual framework. Some authors focus on a conceptual framework as

argumentation for the study (Marshall & Rossman, 2016; Ravitch & Riggan, 2017), while some perceived a conceptual framework as explanatory (Anfara & Mertz, 2015; Miles et al., 2014), whereas, Robson and McCartan (2016), specify variable relationships and research design.

Miles, Huberman, and Saldana (2014:20) define a conceptual framework as *"an explanation, either graphically or in narrative form, of the main things to be studied – the key factors, variables, or constructs, and the presumed relationships among them."*

According to Maxwell (2013), the conceptual framework's purpose is classified into argumentation, explanation and generation. Argumentation focuses on the importance of the studying topic, the appropriateness of the design, and the rigour of the methods. The explanation emphasises the relationships among who and what will be studied.

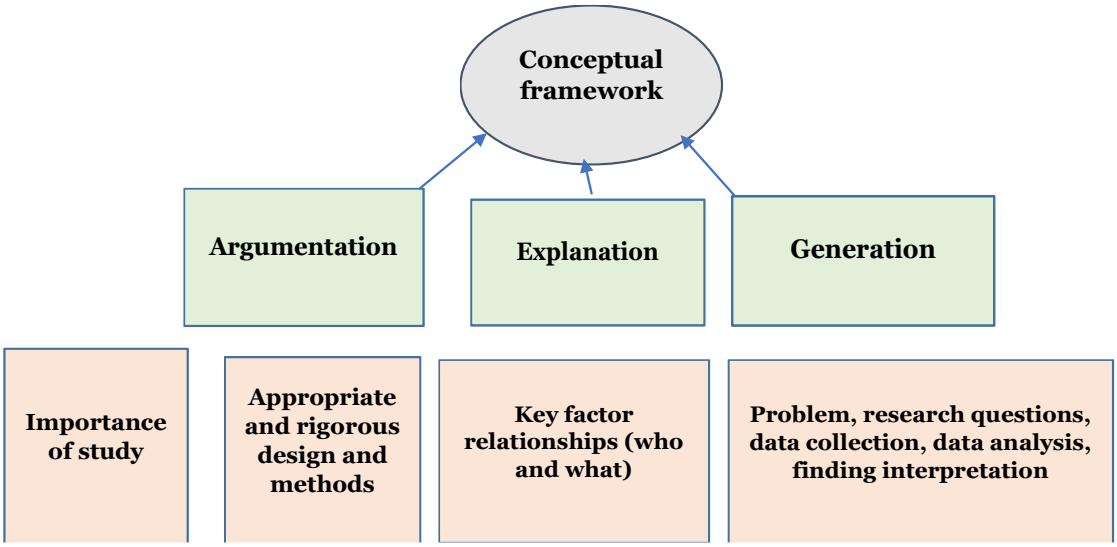

Figure 3.3: Illustration of a conceptual framework's purposes

However, in practice, this section deals with the concepts of science curriculum and how it is delivered in the classroom as well as the interrelatedness of the concepts. It further provides a strong argument and explanation of the need for CPD programmes which can assist a quality and effective science curriculum delivery by the teachers.

3.4.1 Curriculum

Some authors ascribe the derivation of the word 'curriculum' to the Latin word currere, thus the first meaning was 'a running', 'a race' or 'a course', and the second meanings were a racecourse or a career (Olibie, 2014), or courses to cover (Ornstein & Hunkins, 2009). A detailed description of the derivation of curriculum by Ofoha et al. (2009) indicated that the word 'curriculum' came from the Latin word currus, meaning 'a racecourse' or 'a chariot'. The word currus evolved from the word currere, which meant to run. In a nutshell, the original meaning of curriculum was a course of study to be run or completed in an educational institution (Ofoha et al., 2009).

Curriculum as a term is mostly used among learners, academics, institutional management and policy makers from different settings (Fotheringham et al., 2012), and

having a universal acceptable definition for it is difficult and has become a challenge (Tabaundule, 2014)

However, according to Brown (2014:4), the term curriculum can be interpreted in two ways; firstly, it can be interpreted as fact, practice, or social conflict in the line of political power. Secondly, curriculum can be interpreted in analysing the nature of what is taught in schools therefore taking curriculum as race, gender, aesthetic, etc.; thus, this means that the term 'curriculum' means many different things to many people.

In previous works of Smith Stanley and Shores (1957 in Bloom, et al., 2006), the curriculum was considered as an order of potential experiences set up in the school to discipline children and youth in cluster ways of thinking and acting.

Curriculum has also been defined as a course of study or a plan for learning that's a subject matter to be covered by students (Pratt, 1994) though it was incomplete and narrow.

Taba (1962, in Cincioglu, 2014:27) defines curriculum as "*all the learning of students which is planned and directed by the school to attain educational goals."* McGinn and Borden (1995:1) described curriculum as that "*which defines for teachers the skills and knowledge that students should learn."* Curriculum can be summarily defined as *"a plan or programme the learner encounters under the direction of a school."*

Adu and Ngibe (2014:5) define curriculum as *"the offering of socially valued knowledge, skills and attitudes made available to learners through a variety of arrangements during the time they are at school."*

Based on the work by Wang, curriculum

> *"relates to: a) What learners learn (syllabus); b) How teachers help students learn (pedagogy); c) Using supporting materials such as textbooks; d) Using methods of assessment such as testing; e) The kind of facilities such as classrooms, laboratories, workshops, sports fields and; f) Employing whatever means of assessment."* (Wang, 2006 3)

Above all, Gravett et al. (2018) referred to curriculum as to all the learning that is planned and guided as a form of knowledge to achieve certain outcomes in the teaching-learning process as realised in praxis.

It should be understood that curriculum is not static and stale knowledge but is dynamic and constantly evolving (Chin & Poon, 2014; Joskin, 2012). This statement was also supported by Fotheringham et al. (2012), who also recognise changes that take place in learning in line with the changing needs and contexts of society. The changes in the curriculum within the society make it imperative that new knowledge ought to be developed to meet the expectation required in achieving the desired outcome in the context of this study.

3.4.2 Science curriculum and implementation

According to Xhomara (2018:2), "*science curriculum is an important part of learners' formation with knowledge, skills, and competencies*." Science education provides the most critical knowledge for preparing learners to pursue major courses, i.e. medicine, pharmacy, engineering, computer science, etc. (Cho & Baek, 2019).

Science education in South Africa has recently been receiving some outcry but insufficient attention from various education stakeholders due to the learners' poor performances in international assessment studies such as Trends in International Mathematics and Science Study (TIMSS, 2002; 2011; 2015; 2019). However, the National Development Plan Vision 2030 (The Presidency, 2011) emphasises the importance of high-quality science and mathematics teachers. The former Minister of Education (Pandor, 2008) identified the unhappy performance of learners in science and mathematics as a major concern and a factor contributing to the skills shortage impacting the country's economy.

The National Development Plan Vision 2030 (The Presidency, 2011) re-emphasises that good science and technology education is vital for South Africa's future innovation and important to development as they strengthen economic advances, improvement in health systems, education, and infrastructure. Science and technology are key differentiators

between countries that can tackle poverty effectively by growing and developing their economies and those that are not.

Science curriculum comprises mainly four courses: physics, chemistry, biology, and earth science. Some curricula, apart from these basic courses, include technology, environmental protection, and health education (European Education and Culture Executive Agency, 2011).

In European countries for example, the science curriculum in primary education is taught in an integrated form; however, in lower secondary and upper secondary education, it is taught in separate courses (Xhomara, 2018).

Nonetheless, in South African schools, science subjects are categorised and taught differently from phase to phase. For example, in the foundation phase, from Grade R-3, there is no evidence of teaching or learning of a science curriculum in this phase. The intermediate phase comprises Grades 4-6. Science is taught in this phase as natural sciences and technology. However, science is taught separately in the senior phase, Grades 7-9. The natural sciences curriculum in this phase comprises multi-discipline subjects, i.e., Life science, physical science, geography, and astronomy. Whereas, in the further education and training (FET) phase, Grades 10-12, science education is taught separately, i.e., Life sciences, physical sciences, and agricultural science (DBE, 2011).

The outcomes-based education (OBE) curriculum, even though it is technically no longer in place, explicitly encouraged an approach to learning which is activity-based and learner-centred. The Curriculum and Assessment Policy Statement (CAPS) for sciences, i.e., Life sciences (DBE 20011: 5), stated that the critical outcomes learners should achieve include being able to:

- identify and solve problems and make decisions using critical and creative thinking;
- work effectively as individuals and with others as members of a team;
- organise and manage themselves and their activities responsibly and effectively;

- collect, analyse, organise and critically evaluate information;
- communicate effectively using visual, symbolic and/or language skills in various modes;
- use science and technology effectively and critically, showing responsibility towards the environment and the health of others; and
- demonstrate an understanding of the world as a set of related systems by recognising that problem-solving contexts do not exist in isolation.

In addition, in reference to the CAPS document (DBE, 2011:8-9), learners studying and learning about life Sciences will develop the following:

- their knowledge of key biological concepts, processes, systems and theories;
- an ability to critically evaluate and debate scientific issues and processes;
- greater awareness of how biotechnology and knowledge of life sciences have benefited humankind;
- an understanding of how humans have impacted negatively on the environment and organisms living in it;
- a deep appreciation of the unique diversity of past and present biomes in Southern Africa and the importance of conservation;
- an awareness of what it means to be a responsible citizen in terms of the environment and lifestyle choices that they make;
- an awareness of South African scientists' contributions;
- scientific skills and ways of thinking scientifically that enable them to see the flaws in pseudo-science in popular media; and
- a level of academic and scientific literacy that enables them to read, talk about, write and think about biological processes, concepts and investigations.

According to DBE (2011:12), Life sciences, like any other science subject, has the following purposes in its study: *"The* development *of Scientific Knowledge and Understanding."*

Scientific knowledge and understanding can be used to answer questions about the nature of the living world around us. It can prepare learners for economic activity and self-expression, and it lays the basis of further studies in science and prepares learners for active participation in a democratic society that values human rights and promotes acting responsibly towards the environment.

a. The Development of Science Process Skills (Scientific Investigations)

The teaching and learning of science involve the development of a range of process skills that may be used in everyday life, in the community and in the workplace. Learners can gain these skills in an environment that support creativity, responsibility and growing confidence. Learners develop the ability to think objectively and use different types of reasoning while they use process skills to investigate, reflect, synthesise and communicate.

b. The Development of an Understanding of Science's Roles in society

Both science and technology have made a major impact, both positive and negative, on our world. A careful selection of scientific content and the use of a variety of methods to teach and learn science should promote the understanding of science as a human activity as well as the history of science and the relationship between Life sciences and other subjects. It also helps learners to understand the contribution of science to social justice and societal development as well as the need for using scientific knowledge responsibly in the interest of ourselves, society and the environment. Moreover, understanding science also helps us to understand the consequences of decisions that involve ethical issues.

It is important to note that language is very important to consider teaching and learn science according to the above-listed purpose, both the language of instruction and the learner's mother tongue (Netshivhumbe & Mudau, 2021).

It is believed that secondary school science is viewed mainly as a practical subject worldwide. In addition to practical work, language – often written (as in science texts) or oral (as in the form of teacher and learner talk) – is unavoidable in the effective teaching

and learning of science (Oyoo, 2012). Furthermore, language plays an important role in the classroom, especially in the teaching and learning of science.

According to Oyoo (2012: 849), findings have suggested that the use of (instructional) language in science texts and classrooms can be a major influence on the level of students' understanding and retention of science concepts.

Science is regarded as having its own language, i.e., the academic language in science. Academic Language in Science is the formal, precise terminology used in discipline-or domain-specific ways by those fluent or literate in that discipline (McComas, 2013). Learners must be determined and familiar with the meaning of symbols, key terms, and other domain-specific words or phrases used in a specific scientific or technical subject.

Science teachers, therefore, must support science learners who must navigate these new terms, phrases, symbols, and terminology but whose language of instruction is not the same as their mother tongue or native language. This problem is very specific to science learners in rural areas. For example, Life sciences as a subject comprises structures such as "Substance" and "Syntax". The Substance (terms, concepts, vocabularies, terminologies, etc.) and the Syntax (science process skills- measurement, calculation, hypothesis, etc.) both deal with language, and language is used to express these and give meaning to each other, although the syntax is very important to inquiry-based teaching.

3.4.3 Science teachers' curriculum implementation and Continuing Professional Development programmes

To advance science education in South Africa, improving the quality of the science teachers produced, and developing CPD programmes for the science teachers are very fundamental and needed because there are challenges encountered by these teachers in the teaching of science at schools (Netshivhumbe & Mudau, 2021).

3.4.3.1 Science teachers' curriculum implementation in the classroom

Several factors affect science teachers in implementing the science curriculum effectively, and this can be attributed to the following: non-availability of well-trained and qualified science teachers; non-availabilities of resources in the teaching of science; usage of inappropriate teaching strategies by the teachers; the language of science teaching; time allocation; and lack of parental support (Netshivhumbe & Mudau, 2021).

A study by Alebous (2021) revealed that teachers who do not specialise in the science subject but were compelled to teach it as a result of shortages struggled to deliver the curriculum because of their limited subject knowledge matter (SKM) and pedagogical content knowledge (PCK). These teachers were sometimes temporarily asked to teach as their schools awaited appointments of specialised teachers by the Department of Basic Education (Bantwini, 2010 & 2013). From my view, it is obvious that the curriculum will be poorly delivered regarding scientific literacy and inquiry in these circumstances. The teachers may just select what they can teach and ignore the material they cannot teach (Adeniran, 2020)

Another set of teachers is those whose background in science included finishing their pre-service training without having completed all aspects of science, which are central to the scientific enterprise, such as investigations. These very teachers were taught traditionally; they were not exposed to learner-centred teaching. These deficiencies in practical skills and conceptual understanding are being passed on from teacher to learner. The learner later becomes a teacher, thereby perpetuating the cycle from one generation to the next (Bantwini, 2015). In other words, poor teacher education could also lead to teachers' verbatim reliance upon textbook notes and chalkboard teaching and, therefore, create an inability to use science equipment (Du Plessis & Mestry, 20219). Science teaching is known to be a practical subject, but the lack of science training and experience in conducting investigations, coupled with the changes to outcomes-based pedagogy, contributes to the problem of having science teachers who have minimal skills in conducting inquiry-based activities or strategies to promote them (Maharajh et al. 2016).

3.4.3.2 Science teaching strategies

Teaching the science curriculum effectively in science classrooms requires teachers to have knowledge and skills to choose an appropriate teaching strategy that can also be acquired through CPD programmes. Teachers teaching sciences in rural areas often ask a question: What can be done to teach sciences more efficiently to learners whose language of teaching and learning is different from their mother tongue? The teaching strategy of a teacher presented in a lesson can determine the effectiveness of learners' understanding and contribute to their academic performance (Netshivhumbe & Mudau, 2021). Teaching and learning of science need both theoretical and practical knowledge; this means that science teachers must be skilled and knowledgeable in adopting a relevant teaching strategy such as the use of inquiry-based learning, making use of analogies, using a graphic organiser and group work, i.e. collaborative group work and cooperative learning (Ferreira, 2011; Netshivhumbe & Mudau, 2021).

Furthermore, apart from choosing suitable teaching strategies to teach science, the teachers will also need resources. Learning and teaching support materials (LTSM) aids the teaching and learning of science when the required materials are made readily available. These includes textbooks, laboratories, computers, libraries and classrooms (Adeniran, 2020). Nonetheless, teachers need further knowledge and skills to identify and choose which teaching strategy and LTSM are required for a specific science topic. This knowledge and skills can be acquired through CPD programmes for teachers.

3.4.3.3 Science curriculum and continuing professional development programmes

For a science curriculum to be effectively delivered, a CPD programme which addresses the needs of the science teachers have to be developed, and it must incorporate all the curricula components, such as pedagogical knowledge, teaching strategies, methodology, and language of science (science literacy and science skills).

As we know, science as a subject, for example, Life sciences, comprises structures such as "Substance" and "Syntax." The Substance (terms, concepts, vocabularies, terminologies, etc.) and the Syntax (science process skills – measurement, calculation,

hypothesis, etc.) – both deal with language, and language is used to express these and give meaning to each other, although the syntax is very important to inquiry-based teaching and learning, and the teacher who teaches this must be competent to deliver it appropriately.

The diagram in Figure 3.4 illustrates and summarises the conceptual framework of this research study. A designed CPD programme is offered in a workshop organised by the facilitator to the science teachers. The programme is developed and designed from a selected topic or topics in the subject curriculum which the teacher identified as being problematic to them. The CPD interventional programme is designed in such a way to include all the components necessary for the teachers to know and learn, aimed to enhance their curriculum delivery of the subject. This includes content knowledge/ pedagogical content knowledge, teaching methodology/ strategies, language of science, i.e. substances (science literacy, concept, vocabularies and terminologies, etc.) and syntax (process skills).

After the teachers have undergone this CPD programme in the workshop, they will automatically take the knowledge and skills acquired from the workshop to their respective classrooms and pass them unto their science learners during their lesson presentation. However, this can only be tested during the lesson presentation observations.

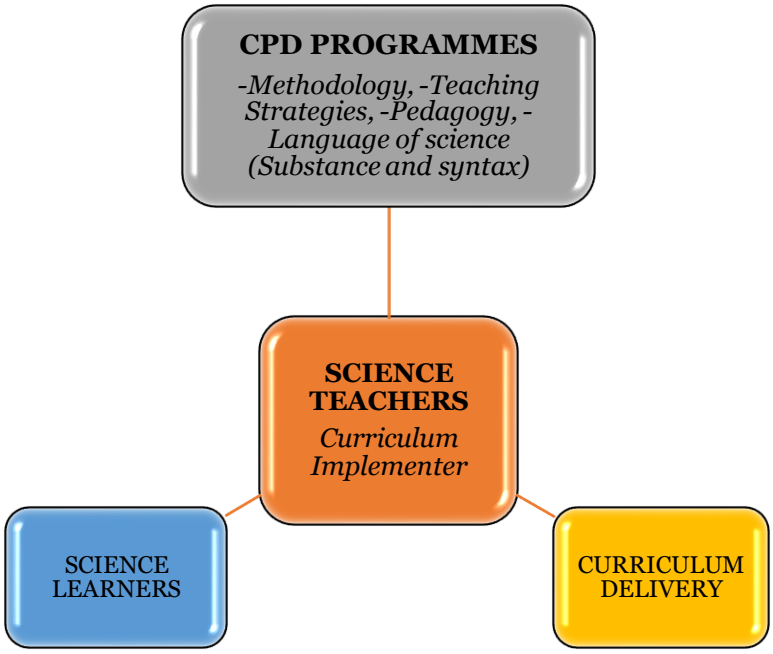

Figure 3.4: Flow pattern of a CPD programme

Figure 3.4 illustrates the flow pattern of a CPD programme for science teachers. According to the flow pattern, the CPD programme includes all the necessary components that will assist the teachers in delivering an effective curriculum of the subject in their respective classrooms. The components will be exhaustively discussed and presented to the teachers during the workshop. Nonetheless, the teachers, in turn, will acquire more knowledge and skills with an object to enhance and strengthen their curriculum delivery. Above all, this knowledge and skills the teachers acquired will be passed on to their learners during their classroom practices.

3.5 CHAPTER SUMMARY AND IMPLICATIONS FOR EMPIRICAL STUDY

In this chapter, the thoughts and research findings from the literature and related articles regarding Grade 10 science teachers' perceptions of CPD programmes as an intervention to improve curriculum implementation led to the identification of relevant learning theory underpinning this study. The theoretical framework, namely, social constructivism or socio-constructivist theory of learning founded by Lev Vygotsky (1978), was presented on how Grade 10 science teachers can improve their curriculum implementation through a CPD programme as an intervention during a workshop organised for them.

In addition, a critical discussion of the conceptual framework of this study was elaborated by emphasising the identified themes. This review was done extensively by referencing relevant literature to verify the concepts of curriculum, science curriculum and implementation, factors affecting science teachers to deliver the curriculum effectively, and the importance of the CPD programme to science teachers in curriculum implementation. Although some teachers alluded to CPD programmes being helpful, many still disagreed. The teachers who disagreed said that they were not pleased with how the CPD programmes were designed because it did not address their needs. Others said that they were not consulted, rather, it was just forced on them. Consequently, they could not indicate the areas on which they needed assistance and support. Therefore, the gap between teachers' needs in CPD programmes aimed to improve their curriculum delivery and the nature of CPD programmes planned for them must be bridged. An effective CPD programme must be designed to address the needs, particularly the curriculum challenges of the teachers.

Finally, a diagram that summarises and illustrates the process of CPD programme was drawn; it shows the connections between the components, for example, how a CPD programmes was presented to the science teachers, who are referred to as curriculum implementers. In the process, they acquired skills and knowledge to enhance their classroom practices.

The next chapter, Chapter 4, will deal with the research methodology of this research study. The chapter articulates the methodology used in this research study. It also presents the research design and method, population and sampling, and data collection and analysis methods.

CHAPTER 4

RESEARCH METHODOLOGY

4.1 INTRODUCTION

The main purpose of this chapter is to provide answers to the main research question and research sub-questions as stated in Chapter 1, Sub-sections 1.5.1 and 1.5.2 respectively.

This chapter discusses the research strategy used in this research study comprehensively. It describes the research design and methods for the empirical research employed in the study. As part of the research methods, the research instruments, the data collection and data analysis processes and methods are described. In addition, the chapter provides detailed information on the research method, the procedure used to collect data and data analysis strategies.

4.2 RATIONALE FOR EMPIRICAL RESEARCH

Conceptual, theoretical and contextual research concentrates on the concept or theory that describes and clarifies the phenomenon being studied using desk analysis (Enago Academy, 2016). This approach implies that one sits at a desk to search for relevant literature to assist in getting a deep knowledge and understanding about the study that is being investigated, as well as finding a theoretical solution to it without attempting to find out whether the solutions work or not. However, for this study, it was essential to involve empirical data from field work and not just do desktop research on data of evidence from the conceptual, theoretical and contextual framework. For example, in the context of this study, conceptual research assisted me in understanding the factors that hinder effective curriculum implementation in schools, especially amongst science teachers, as well as determining the impact of CPD programmes. In addition, it helps me to know what past studies say about how science teachers can implement and deliver an effective curriculum in their respective classrooms despite continuous curriculum reforms.

It is essential to be more practical in the research study and to ensure that the problems under study are investigated first before drawing conclusions from empirical research.

According to Enago Academy (2016), research results may not be valid if one bases them on theories alone, as the case may be in conceptual and theoretical research. Therefore, empirical research is necessary because the result obtained will validate and authenticate the theory or theories adopted by the research study. Hence, empirical research serves as backup evidence, which assists one in understanding events as they occur (Bradford, 2015).

In this study, the purpose of including empirical research is to capture the real experiences and individual thoughts of the Grade 10 science teachers' perceptions of CPD programmes in improving their curriculum implementation. This research was done through pre-semi-structured interviews and pre-lesson observation, which I conducted with the teachers. Thus, this approach assisted and guided me on designing an interventional CPD programme, which was presented to the participants in a workshop. During those processes, data were collected and recorded. During the interventional CPD programme, I acted as a facilitator and mentor while the teachers interacted and worked together. Since it was important to this study to gain an in-depth understanding of whether the organised CPD programme assisted the science teachers or not, I again interviewed the teachers after the workshop (post-semi-structured interview) and observed the lesson presentations (post-lesson observation). Thus, the data collected through empirical research was analysed and compared with the information gathered from the literature and the theoretical framework to corroborate the findings.

4.3 RESEARCH DESIGN

Creswell (2013) says research design is a strategy and design of a research study that offers a holistic pattern of data collection. In addition, research design can be described as a strategy and procedure for the study, providing an overall pattern for collecting the data. It outlines the detailed stages of the study and provides procedures for systematic sampling techniques, the sample size, instruments and data-gathering decisions from broad assumptions to detailed data analysis methods (Creswell, 2013). However, research design not only deals with the pattern of data collection but also describes how, when and where data are to be collected and analysed (Rahi, 2017). Therefore, I describe research design as a structure for planning, implementing and analysing a study.

Creswell and Plano Clark (2017) describe a research design as a method for collecting, analysing, interpreting and recording data in a study. The description of research design by Creswell and Plano Clark (2017) is the most acceptable and adoptable definition for my study because it is not only about planning but includes the method of collecting, analysing, interpreting and recording the data. Above all, it seeks to understand human and social behaviour; individual and group social actions, beliefs, thoughts and perceptions are described (MacMillan & Schumacher 2014). This definition is also very valuable to my study because the research seeks to get the science teachers' perceptions of CPD programmes as an intervention in improving their curriculum implementation.

This research study adapts a case study design (Yin, 2014). The sample was drawn from twelve secondary schools. Participatory Reflection and Action (PRA) was used as the research design and mode of inquiry.

Participatory Reflection and Action, referred to as Participatory Rural Appraisal in the early nineties (Chambers, 1994), can be described as both an approach and a method. It is ontologically rooted in an interpretative paradigm as one collects data from workshops, analyses and interprets the data collected. Some scholars also argue that PRA is closely related to Participatory Action Research (PAR), which has become known for emancipating and empowering qualities. Nonetheless, for this study, I used PRA because it is ontologically entrenched in an interpretative paradigm wherein one collect data from the workshops, analyse and interprets the data collected (Chambers, 1994b). In this vein, I decided to organise a workshop for the participants (Grade 10 science teachers) wherein an interventional programme in the form of a CPD activity would be conducted.

PRA is critically concerned with poor and resource-constrained communities and enables community members to share, analyse and co-generate knowledge about their health-related needs and perceptions. It is also supported by the theoretical framework as stated in Chapter 3, Sub-section 3.3. The value of PRA is that the science teachers, especially these rural communities, could provide their views on the CPD programmes. A participatory reflection and action-based approach can be applied in community-based

education interventions in most communities in the world (Chambers, 1994a, 1994b). It allows a more detailed understanding of learners', teachers' and community members' experiences, perceptions and beliefs. The participatory reflection and action-based approach gathers local knowledge, together with the critical role of participants during the research process (Von Maltzahn & Van Der Riet, 2006).

The following steps were followed to apply PRA, and it will be discussed under data collection in detail:

i. Identify the problem
ii. Develop a plan of action
iii. Collection of data
iv. Analysis and conclusion
v. Reflection.

It should be noted that PRA focuses on practical problems and provides possible solutions. Specifically, I acted as a facilitator and mediator in this research study to plan and implement the interventional CPD programme.

4.3.1 Interpretivist research paradigm

A paradigm can be described as a broader way of thinking, as well as the basic beliefs and values that guide the conduct of a researcher (Fletcher & Zuber-Skerritt, 2007). This means that it gives an overview of how research is conducted. In this research study, the philosophy that I chose to adopt was an interpretive paradigm. According to Neuman (2017), an interpretive paradigm is a socially meaningful action of an organised analysis through straight and in-depth observation of people in an environment to reach a certain perception and explanation of how the people form and uphold their social world. In this study, I explored the science teachers' experience of CPD programmes to understand and improve the teachers' curriculum delivery. The interpretive paradigm will allow participants to interpret and understand the teachers' views of CPD programmes.

Abdulkareem, Ismaila and Jumare (2018) agreed that the paradigm enables researchers to assess the basic belief and structures that control their research study. In the words of

Rahi (2017), a research paradigm is a vital belief shared by researchers about how problems are to be understood, how the world is viewed and how to conduct research. In other words, a research paradigm influences a research methodology to be used in a research study, especially in reference to why a researcher collects data, what kind of data is to be collected, where such data can be collected, the data collection procedure to be used, and how the data can be analysed, interpreted and reported. In addition, the interpretive paradigm considers ethical issues by treating its participants with respect, and the researcher empathises with the participants to ably capture and loyally answer questions about what is going on in their social world (Okeke & van Wyk, 2015). Since interpretivism focuses on human interpretation of the social world, it is therefore very important in this research study that I obtain the perceptions of the participants (Grade 10 science teachers) concerning their views regarding CPD as an interventional programme in implementing the curriculum. The teachers would be requested to give their views after the intervention on whether or not the CPD programme impacted their curriculum delivery, in as much that one of the objectives of the interpretive paradigm is to gain in-depth information and understanding about the research study.

Furthermore, as much as my study is based on an interpretive paradigm, the information obtained through data whilst seeking answers to both the main and sub-research questions would thus assist me in interpreting and developing new knowledge.

This qualitative research study used a case study based on interpretivism, where data were widely collected from the Grade 10 science teachers teaching Life sciences (participants) over a specific period. Additionally, interviews and observations were used as interpretive approaches to obtain qualitative data in this study. It is important to note that data were collected through interviews and observation before and after the interventional CPD programme. I collected, transcribed, coded and analysed the data.

4.3.2 Research approach

A research approach can be described as a strategy for research from the initial decisions on the broad assumptions throughout the exhaustive procedures of data collection, analysis, and interpretation (Creswell, 2012). In my own words I can summarily say that

a research approach can be perceived as a method in which a choice is made in a study pertaining to the research design, research method, and strategies for collecting and analysing data. There are various approaches overall approaches that a research study can adopt, such as qualitative, quantitative, and mixed methods approach (Okeke & van Wyk, 2015).

Nonetheless, the qualitative research approach was chosen for this study because it aligned with the research paradigm and theoretical framework. More so, it was the most suitable way to answer to the research questions. This decision was made as the research is mostly concerned with the qualities, characteristics, and properties of a phenomenon under research, which in this case are the perceptions of Grade 10 science teachers teaching Life sciences as they engaged in professional development programmes to improve their curriculum implementation. In addition, I chose this technique because the study's participants shared their personal experiences, reflections and opinions about CPD programmes as an interventional support to improve their curriculum implementation in the Grade 10 Life sciences classroom. As in all social research, this research sought to understand human and social behaviour; and, therefore, explore the individual and group social actions, beliefs, thoughts, and perceptions of the participants during their experience of the phenomenon (MacMillan & Schumacher, 2014).

Qualitative research involves investigating, collecting, analysing evidence and then constructing a theory. Qualitative research is mainly interactive and uses face-to-face methods by interacting with selected people in their natural settings. The interactive research approaches can be chosen from ethnography, phenomenology, case study, grounded theory, or critical studies.

Qualitative research benefits the researchers because they gain the participants' perception of the phenomenon due to their close involvement in the research. Also, it allows the participants to express themselves in their words and actions (McLeod, 2017).

Qualitative research acknowledges an interactive relationship between the researcher and participants, and the participants and their own experiences and how they have

constructed reality based on the experiences. Additionally, the interactive relationship between the researcher and participants provides an opportunity to the researcher to observe, record and interpret non-verbal communication as part of the respondents' valuable feedback during interviews, discussions and analysis (Maree, 2008; Qualitative Research Consultants Association, 2017).

4.3.3 Research strategy

Research type or strategy is generally planned in the execution of research that has clear objectives and features derived from research questions, indicating the sources where the researcher plans to collect data, but also considering the limitations experienced by the researcher, which may include the availability of data, sufficiency of time, proximity of location and sufficiency of resources such as finance (Saunders, Lewis &Thornhill, 2012).

According to Macmillian and Schumacher (2014), a case study concentrates on one structure (an individual or distinct group). In support of this notion, Hardwick (2017) describes a case study as the study of one or many instances of a particular phenomenon to explore the context of the same phenomenon. Therefore, a case study is defined as a design that observes a restricted structure or situation within a certain period, using several data sources available in the site (MacMillan & Schumacher, 2014). In a case study, the researcher concentrates on a specific case with special characteristics (Atmowardoyo, 2018).

Nevertheless, this research used a multiple case study; with 12 different schools taking part in the research. A multiple case study explores a real-life multiple bounded system through detailed, in-depth data collection involving multiple sources of information (Creswell, 2013; Gustafsson, 2017). Furthermore, a multiple case study is a valuable qualitative research tool in studying the links between the personal, social, behaviour, psychological, organisational, cultural, and developmental factor that guide organisational and leadership development (Halkias, Neubert, Thurman & Harkiolakis, 2022).

The reason why this research study used a multiple case study was basically because it involved twelve (12) different secondary schools in Ngwaritsi circuit, Sekhukhune South

district, Limpopo Province, and these schools were grouped into three categories. The advantage of using multiple case study in this research study was that it allowed me to explore and have a deep understanding of the participants' views towards CPD programme as an interventional support to improve their curriculum implementation. Although, it required more time, resources and efforts from both me and the participants. The next section will deal with the data collection procedure for this research study.

4.4 RESEARCH METHODS

This section is essential in any research study, including this study. Research method deals with the population, sampling procedure, method of data collection, analysis and interpretation of results, all of which play a role in collecting relevant information to answer the research questions (Creswell, 2014). Atmowardoyo (2018) also states that researchers use research methods to describe the techniques used in conducting research and finding solutions to research questions. Moreover, it deals with the conduct and tools used to perform research processes such as observing, recording data, and processing data procedures.

Therefore, I detailed the research methods used in this study in this section to answer the research questions.

4.4.1 Selection of participants

The selection of participants in research study is otherwise referred to as sampling. A. sample is a subgroup of a population that is selected from a fragment of the population that agrees to participate in a research study (Denscombe, 2014). Okeke and van Wyk (2015:226) define a sample as "*a set of respondents or participants selected from a large population for the purpose of conducting a survey.*" In a nutshell, a sample is chosen in some way from a population which the researcher considers important in the research process, and from whom the data are collected. Therefore, one must utilise a sample of participants from the population one is studying (Brown & Hale, 2014), where a population is a group of individuals, objects or substances from which samples are chosen (Okeke & van Wyk, 2015).

In this study, Grade 10 sciences teachers teaching Life science were selected from 12 secondary schools to represent the larger population. Thus, in this research study, one Grade 10 sciences teacher who is currently teaching Life science was selected from each of the 12 secondary schools in the Ngwaritsi circuit of Sekhukhune South District, Limpopo province. The 12 secondary schools in the circuit had only one science teacher each teaching Life sciences in Grade 10. Therefore, a total number of twelve (12) Grade 10 Life sciences teachers participated in the study. The biographical data of the participants was explained in detail in Chapter 5, subsection 5.3.1.

Table 4.1 Distribution of participants per school.

Grade 10 science teachers teaching Life sciences (Participants)	**Acronym for each participants**	**School performance**
Teacher 1	T1	Above performer
Teacher 2	T2	Above performer
Teacher 3	T3	Above performer
Teacher 4	T4	Average performer
Teacher 5	T5	Average performer
Teacher 6	T6	Average performer
Teacher 7	T7	Average performer
Teacher 8	T8	Below average performer
Teacher 9	T9	Below average performer

Teacher 10	T10	Below average performer
Teacher 11	T11	Below average performer
Teacher 12	T12	Below average performer

Furthermore, the twelve secondary schools were grouped into three categories based on their Grade 12 matriculation performance. Practically, there are twelve (12) secondary schools in the Ngwaritsi circuit of which three (3) are performing above both the national and provincial benchmarked percentage pass rate. Similarly, there are four (4) secondary schools in the circuit with an average performance, while the other five (5) secondary schools are performing below the national average. A total of twelve (12) Grade 10 Life science teachers form the population of this study. Above all, the school's academic performance is classified as follows:

i. Above-average performing schools (above 80% matric pass rate)
ii. Average performing schools (within the range of 50-80% matric pass rate)
iii. Below-average performing schools (Below 50% matric pass rate)

The twelve (12) secondary schools in the circuit were grouped into three categories according to their academic performances: Category A – above performing schools; Category B – average performing schools; and Category C – below average performing schools.

Furthermore, three out of the twelve secondary schools in the circuit were selected as centres wherein individual interviews and lesson presentation observations were conducted by me with each of the participants. These centres are Centre ‘A’, Centre ‘B’ and Centre ‘C’, respectively. In addition, the three schools referred to as centres were chosen based on their proximity to one another and for the participants’ conveniences. For example, the above-performing schools are closer to each other, just as the average-

performing schools are closer to one another. The below-performing schools are scattered far apart in the deep rural area. However, for the convenience of the participants who fell under this category, a school was identified and chosen as a centre.

In centre 'A': Each of the three participants representing their individual performing schools (Category 'A') met at this centre, I collected data from each of them through semi-structured interviews and lesson observations in the centre.

Centre 'B': This was where the four participants met for the collection of data by me through semi-structured interviews and lesson observations. Each of the participants was representing their average performing school (category 'B').

Lastly, in Centre 'C': there were five participants who assembled at the centre wherein I collected data from them through the semi-structured interview and lesson observations. Each of these participants represented each of their below-average performing schools (Category 'C').

Table 4.2 Summarises the features under each of the categories.

Table 4.2:Distribution of participants into categories

Category A	**Category B**	**Category C**
Above performing schools	Average performing schools	Below average performing schools
Centre A	**Centre B**	**Centre C**
Three (3) schools	Four (4) schools	Five (5) schools

Number of teachers	Number of teachers	Number of teachers
Three (3)	Four (4)	Five (5)

Each of the participants (Grade 10 sciences teachers teaching Life sciences) was interviewed by me. These interviews (i.e., pre-semi-structured interview and post-semi-structured interview) took place in their respective centres, and according to their categories. Moreover, there were lesson presentations by each of the participants. I observed these lesson presentations during their individual lesson presentations. The lesson presentations were divided into two parts (i.e., pre-observation and post-observation). Both the pre-semi-structured interviews and pre-lesson presentation observations took place before the CPD programme interventional workshop. In contrast, the post-semi-structured interviews and post-lesson presentation observations were conducted after the CPD programme interventional workshop.

4.4.2 Process of data collection involving Participatory Reflection and Action

The collection of data goes beyond interviewing or observing the participants by a researcher, but on whether to interview or observe participants and sites but also encompasses gaining access, deciding on the kind of data to collect, designing or developing forms for data collection and managing the process according to ethical guidelines (Creswell, 2012). According to Kabir (2017), data collection is a systematic technique of gathering information to enable one to answer the stated research questions, test hypotheses, and evaluate outcomes.

For this research study, data collections are mainly about the main research question, the aim and the objectives of this study. The data collection methods and instruments used were open-ended interviews and observations during lesson presentations.

As I have indicated in Section 4.3, PRA was used as a research design in this study; it served as the method of data collection and intervention (CPD programme workshop). From my point of view, PRA involves a collective and self-reflective inquiry that the researcher and participants undertake to understand and improve upon the practices under study in which they participate and, in the situations, where they find themselves. PRA provide solutions to an identified problem by involving the collective participation of people who can partake in delivering solutions to the problem through a plan of action. In the case of this research study, curriculum delivery and implementation have been identified as one of the major problems science teachers face, especially in rural areas. For this reason, the study explored and established the Grade 10 science teachers' perception of CDP programmes in improving their curriculum implementation. The PRA steps must be followed for data collection, and the process can be described by a circle (von Maltzaln & van de Riet, 2006). The five steps include:

i. Identify the problem – the main problem or situation that require an intervention or solution.

ii. Develop a plan of action – what will be done and how it will be done to address and solve the identified problem. Who will be involved in the planning, and what is their level of involvement in providing solution to the problem.

iii. Collection of data – what kind of data will be collected that will address and provide the solution to the identified problem.

iv. Analysis of data – presentation of the data collection, analysis of the result and drawing of conclusion from the data analysis.

v. Reflection – this is checking the process again and making sure whether or not the intervention work, and the problem is solved.

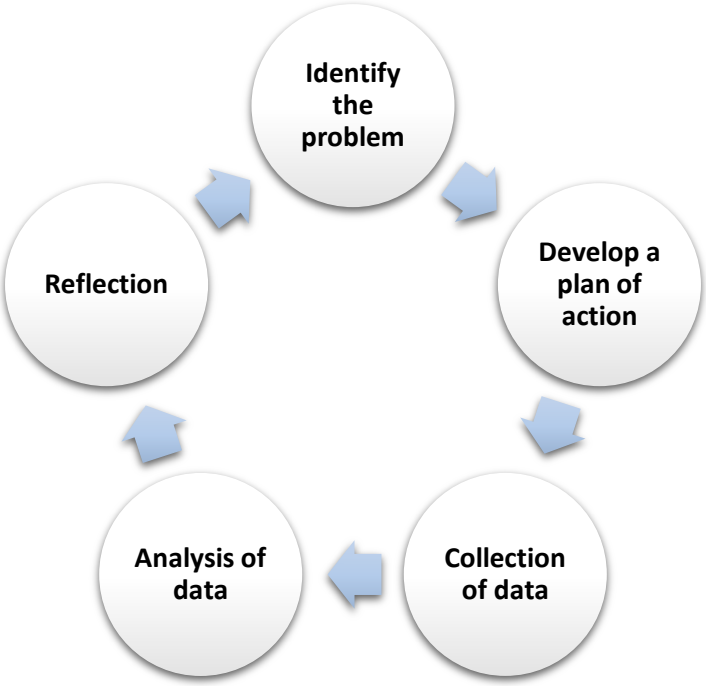

Figure 4.1: Participatory Reflection and Action steps

Source: Research into implementation strategies to support patients of different origins and language background in a variety of European primary care settings (RESTORE): Study protocol (MacFarlane, Donnell, Mair & de Brun, 2012).

The listed steps in Figure 4.1 were applied with the aim of collecting data for study as PRA seeks possible solutions to a practical problem. As indicated earlier, I acted as a mediator to plan and implement the intervention.

(i) Identify the problem

What is the Grade 10 science teachers' understanding and perceptions of CPD programmes in improving their curriculum implementation?

(ii) Develop a plan of action.

The plan of action will be detailed here to give full descriptions on how the intervention is planned and implemented. The plan of action is thus divided into three phases, namely: Phase One (activities before CPD programme intervention workshop), Phase Two (CPD

programme intervention workshop), and Phase Three (activities after CPD programme intervention workshop).

- **PHASE ONE: Activities before the CPD programme intervention workshop.**

Phase one illustrated the activities of actions that took place before the CPD programme intervention workshop (pre-semi-structured interviews and pre-lesson presentation observations). The reason for pre-interviewing the participants (Grade 10 science teachers teaching Life sciences) was to understand the challenges they were facing in delivering the curriculum. The observation of the lesson presentations was aimed at identifying some of the challenges the participants were experiencing and seeing how the interventional CPD programme could address these challenges and improve their curriculum implementation. Above all, both the pre-semi-structured interviews and pre-lesson presentations observations helped me to plan and design an appropriate interventional CPD programme for the participants.

Day 1: Meeting with the participants

I met with all twelve participants (Grade 10 sciences teachers teaching Life sciences) at a common venue. I explained the research study's aim and UNISA's ethical issues regarding research studies to them once again. The participants and I agreed on how the action plan should be structured. For example, the above-performing schools and the three Grade 10 science teachers teaching Life science met at Centre ‘A’. The average performing schools and the four Grade 10 sciences teachers teaching Life sciences met at Centre ‘B’. The below-average performing schools and the five Grade 10 science teachers teaching Life sciences met at Centre ‘C’. Each centre was chosen based on the schools’ proximity to each other and for the participants’ convenience.

The participants were informed that they would be individually semi-structured interviewed and observed during their lesson presentations twice by me at their different centres, i.e., pre-semi-structured interviews, pre-observations and, post-semi-structured interviews, post-observations. However, I provided them with the same topic, taken from

the Life sciences curriculum syllabus in preparation for the first lesson presentations, titled, ‘Organic compounds’ (See *Appendix O*).

The topic addresses both Specific Aim 1 (which relates to subject content- substances) and Specific Aim 2 (Investing phenomena in Life Sciences-syntaxes), according to the CAPS document. The participants developed their lesson plans individually in reference to the topic provided to them, and they presented it to their respective learners in classrooms at their different centres. This allowed me to observe and understand the curriculum challenges the participants were facing in delivering the curriculum.

Day 2: At Centre ‘A’

On the second day, I visited centre ‘A’, where I met with the participants. The three participants (sciences teachers teaching Life sciences) in this centre belongs to Category ‘A’. Category ‘A’ include schools that are performing above average. I therefore spent thirty minutes to interview (see, *Appendix H*) each of these participants. The participants’ responses were written in my research dairy. More so, the semi-structured interviews were recorded, which assisted me with accuracy when I compared them to the responses written in my field notes.

Thereafter, the participants were requested to go to class and teach wherein I observed their lesson presentations one after the other. Each of these participants spent thirty minutes presenting their lessons. I used direct classroom observation, making use of an observation sheet which contained some listed criteria (see, *Appendix I)*. The observation sheet assisted me to identify the challenges the teachers were experiencing in delivering the curriculum.

Day 3: At Centre ‘B’

I visited Centre ‘B’, under category ‘B’, schools performing at an average level. Therefore, the category of teachers in this at those whose schools are performing at an average level. The four participants (Grade 10 sciences teachers teaching Life sciences) in this category, each representing their schools, were semi-structured interviewed by me before going to classes for lesson presentations wherein I observed them individually. It should

be noted that the same process that occurred in Centre ‘A’/ Category ‘A’ also happened here. I spent thirty minutes interviewing each participant and thirty minutes each for the lesson presentation observations.

Day 4: At Centre ‘C’

Similarly, I went to Centre ‘C’ where five participants (Grade 10 sciences teachers teaching Life sciences) assembled. However, all the teachers in this category came from schools performing below average. Likewise, I applied the same process as in Centre ‘A’/ Category ‘A’ and Centre ‘B’/ Category ‘B’. I used semi-structured interview to interview each of the participants for thirty minutes. Thereafter, they went to their classroom to present their lessons, each of them spent thirty minutes, and I observed them individually.

This phase lasted for five days, after which I returned home to plan and design the intervention CPD programme. The participants’ interviews and lesson presentation observation reports were considered to assist me in developing and planning an appropriate CPD programme. After two months, I went back for the phase two process.

- **PHASE TWO: CPD programme intervention workshop.**

In this phase, all the twelve participants (Grade 10 sciences teachers teaching Life sciences) re-convened again in a common venue for the purpose of a workshop. The CPD programme intervention was presented to the participants in a workshop I organised. The participants’ semi-structured interviews and lesson presentation observation reports assisted me in developing and planning the CPD programme for the participants.

The CPD programme involved a two-day workshop organised for the participants. I put the report I gathered during their pre-lesson presentations observations, as well as the answers provided by each of the participants during pre-interviews into context. The CPD programme was designed to address and consider all the factors and challenges observed or identified during the teachers’ pre-lesson presentations and the feedback received during the pre- semi-structured interviews.

During the workshop, an activity was given to all 12 participants. A topic taken from the Life science curriculum syllabus rich in substances and syntaxes was given to the participants and they were requested to work together collaboratively and develop a lesson plan. The topic was 'support and Transport System in Plants' (see *Appendix P*).

The participants worked collaboratively, as a result, they had an opportunity to interact with one another by sharing their own teaching experiences, practices, and views, including debating some of the challenges they faced in delivering the curriculum.

The participants worked together collaboratively to develop a lesson plan based on the topic I gave them. During this process, I served as a facilitator and mentor or mediator to the participants, wherein there were exhaustive discussions between me and the participants. The participants asked me questions in the areas where they needed more clarity and I assisted by providing more information and detailed explanations to their questions. At the end of the workshop, the participants produced their own lesson plan.

In conclusion, at the end of the workshop, the participants returned after five days back to their initial designated centres for the presentation of their lessons and interviews (post-lesson presentations and post- semi-structured interviews).

- **PHASE THREE: Activities after the CPD programme intervention workshop.**

At this stage, the twelve participants returned to their respective centres for the post-semi-structured interviews and post-lesson presentation observations.

Unlike phase one, where pre-semi-structured interviews took place before pre-lesson presentation observations, in phase three, post-lesson presentation observations happened before post-interviews. The reason for this was to combine what I observed in the participants' lesson presentations (post-lesson presentations observations) with their responses during the interviews (post-semi-structured interviews).

The participants were observed using the same criteria as listed in observation tool which was used in the pre-lesson presentation observations (see *Appendix I*). However, another

set of questions was asked during the post-semi-structured interviews (see *Appendix J*). Their responses were captured in my field notes, and the interviews were recorded.

Day 1: At Centre 'A'

In Centre 'A', the three participants (Grade 10 sciences teachers teaching Life sciences) were excited to see me again. The participants were told to go to class and present their lessons based on the lesson plan they had developed during the CPD programme interventional workshop. Each participant presented their lessons for thirty minutes while I observed the lesson presentations. An observation sheet was also used to record the observations. At the end of the lesson presentations, each participant was interviewed with another set of questions (see *Appendix J*) for thirty minutes each.

Day 2: At Centre 'B'

On the second day, I visited centre 'B', where the four participating Grade 10 science teachers teaching Life sciences presented their lessons and were interviewed. Each of them presented their lesson for thirty minutes while I observed. The lessons were presented based on the lesson plan they all developed during the CPD programme interventional workshop. Thereafter, I conducted interviews for each of the participants which lasted for thirty minutes each.

Day 3: At Centre 'C'

At this centre, the five participants (Grade 10 sciences teachers teaching Life sciences) who represented each of their schools were also glad to welcome me. Thus, the participants were told by me to go to classes and present their lessons according to the lesson plan they had developed during the CPD programme interventional workshop. I observed their lesson presentation individually by spending thirty minutes in each of their classes. Subsequent to the lesson presentations, the participants were also interviewed for thirty minutes for each.

4.4.3 Data collection

The data of this research study were collected through semi-structured interviews and structured observations during participatory (cooperative) and reflective lesson presentations.

4.4.3.1 Individual semi-structured interviews

For this qualitative research, interviews were used as the participants' eyes to see the world and obtain valuable and fruitful illustrative data that helps understand the participants' construction of knowledge (Ryan, Coughlan & Cronin 2009). The interview is an essential instrument for collecting data because the participants' views regarding CPD programmes needed to be established in this research.

Okeke and van Wyk (2015:297) define an interview as "*a face-to-face conversational engagement between two people where questions are asked by the interviewer in order to elicit responses that can be analysed within qualitative research situations*."

A semi-structured interview was used in this study to collect qualitative data; this approach does not only collect data, but it also analyse participants' intellectual processes, feelings, and views about a certain topic, and digs into private and sometimes sensitive matters (DeJonckheere & Vaughn, 2019). Furthermore, in this approach, the researcher strictly followed the interview schedule and asked a series of open-ended questions from the participants pertaining to the research subject. In this process, the participants were allowed to express their opinions and experiences openly by exploring their thoughts, feelings and beliefs about the subject matter (DeJonckheere & Vaughn, 2019). Apart from the fact that open-ended questions were used to let the participants express themselves freely, I designed an interview schedule as one of the instruments used to collect data straight from participants. In addition, I could observe the facial expression of the participants; thus, this helped me to probe and get in-depth information from the participants (Kumar, 2018). The participants also knew an audio recording device was used to record all interviews. I knew it was very important for me to take extensive notes of what was said by the participants during the interview processes on

my research dairy and then code and analyse these in various ways. Therefore, in this research study, data were collected through semi-structured interviews and lesson observations from each participant (Grade 10 Life sciences teachers teaching Life sciences). The participants' responses were written on my research diary for transcribing and coding. The interviews took place for thirty minutes for each participant and were audio-recorded.

4.4.3.2 Lesson observation

Observation is beyond watching or looking at things. It often involves systematically noting people, events, behaviours, settings, artefacts, and routines (Marshall & Rossman, 2016; Simpson & Tuson, 2003). An observation can be systematic and structured or adopt some less structured form, an example is participant observation (Denscombe, 2014). One of the characteristics of observation as a research process is that it offers a researcher the opportunity to gather first-hand, raw data from naturally occurring social situations rather than reviewing reported data and second-hand accounts (Creswell, 2013; Wellington, 2015).

Using observation as a research method has the unique strength of giving more valid or authentic data than in the case with mediated or inferential methods (Cohen et al., 2018). Observation is highly resilient on face validity because it can provide rich contextual information, and enable first-hand data to be collected, and can offer an opportunity for documenting those aspects of life-worlds that are verbal, non-verbal and physical (Cohen et al. 2018).

Classroom observation is a highly suitable technique for data collection through which the researcher can observe the research subjects' behaviour directly. In addition, it reveals what people do, which may differ from what they say they do, because it provides a reality check coupled with carefully prepared recording schedules as it applies to this research study.

A direct classroom observation method was chosen as the research method. The science teachers were observed during their lesson presentations in their respective classrooms.

A direct classroom observation method happens when a researcher makes careful observations of one or more specific behaviours in a particular setting that is more structured, for example, such as a classroom (Price, Jhangiani, Chiang, Leighton & Cuttler, 2017). A direct observation will know in advance what it is looking for (i.e. pre-ordinate observation) and will have its observation categories worked out in advance (Cohen et al., 2018). In a direct classroom observation, the researcher is interested in a limited set of behaviours; hence they focus their observation on a very specific behaviour of interest (Price et al., 2017). This process is also in line with the research design, namely PRA. For this research study, a structured observation was used to observe the lesson presentations of the participants (Grade 10 sciences teachers teaching Life sciences). The participants were observed twice (pre- and post-lesson presentation observation). I developed an observation sheet which assisted me in focusing on the specific situation of interest and a lesson observation was done on each of the participants in their respective classrooms. Each lesson presentation observation lasted for thirty minutes.

4.4.3.3 Data analysis

Data analysis is a process whereby a researcher describes, discusses, interprets, evaluates and explains the data in relation to the research questions of the research study (Okeke & van Wyk, 2015). One of the major aims of qualitative research is to generate an individual understanding of people's perceptions, beliefs, and interpretations of the situation around them (Baker & Edwards, 2012; De Vos, Strydom, Fouché & Delport, 2013; Sparkes Smith, 2014). In the context of this study, I desired to explore and establish Grade 10 Life sciences teachers' perceptions of CPD programmes in improving curriculum on my implementation. Therefore, the data collected through the participants' interviews and observations of their lesson presentation were analysed by coding, categorisation and themes. Data analysis in qualitative research embraces coding the data by dividing the text into lesser units, then assigning a code to each of the units and then classifying (categorisation) the codes into themes (Creswell & Plano Clark, 2011). Qualitative data analysis aims to facilitate an understanding of the phenomenon being studied (Sargeant, 2012). Above all, data analysis refers to examining and organising

interview transcripts, observation notes, and other graphic materials gathered by the researcher to gain a better knowledge of the issue during the course of study.

As I have indicated, data collected through individual semi-structured interviews and lesson observations were analysed by coding, categorisation and themes in this qualitative research. Thus, the participants' responses in both the pre- and post- semi-structured interviews provided me with the answers used to determine whether or not the CPD programme intervention assisted the participants in improving their curriculum delivery, and this also provided answers to the main research question.

In my research study, I followed and used the steps proposed by Vaismoradi, Jones, Turunen and Snelgrove (2016) for data analysis. The steps include the initialisation, construction, rectification, and finalisation phases, respectively.

First and foremost, in the initialisation phase, I commenced by transcribing the data of the participants' responses to the semi-structured interviews by reading the notes that I took during the interviews. These research diary's notes were read several times to describe the pattern of the participants' views. The responses of the participants that were audiotaped were transcribed verbatim. The notes taken during the semi-structured interviews and the audiotaped responses were compared so as not to misinterpret or misquote the participants' responses or views. Therefore, I immediately started coding the semi-structured interviews once they were transcribed and reviewed. The coding involves breaking down or reducing the raw data into smaller segments that are important and relevant to the research topic.

In the construction phase I began to group my codes into categories. The grouping into categories is done by looking at the organised codes and comparing them in terms of similarities and differences. Hence, I grouped each of the codes into categories based on their similarities and differences to address the study's research questions.

This next phase is called the rectification phase or better known as verification (Vaismoradi, Jones, Turunen & Snelgrove, 2016). In this phase, I re-code, merge codes and re-categorise the themes; the ideal is to reduce the codes and move closer to

answering the research questions. Furthermore, I ensured that I checked and confirmed the developed themes to ensure they were correct.

In the final phase, I took the codes and categories and used them to construct my final narrative by linking all the themes together to provide answers to my research topic. A model for the CPD programme is therefore developed.

4.5 MEASURES FOR TRUSTWORTHINESS

The trustworthiness of this research study can be maintained by high credibility and objectivity. The researcher not only depended on the review of accessible literature in the library which addressed the topic of the study, instead, I consulted other sources to gather information about the phenomenon.

Trustworthiness in qualitative research can be defined as way of establishing the credibility, transferability, confirmability and dependability of a research study, it is seen as the true value of a research study which reflects the realities of the participants (Devault, 2018).

According Korstjens and Moser (2018), the term trustworthiness, which is fondly used by qualitative researchers describe the process of determining whether the findings can be trusted. The methods used by these researchers to ensure and establish trustworthiness include credibility, transferability, dependability, and confirmability (Connelly, 2016; Devault, 2018).

4.5.1 Credibility

The credibility of data collected in this study is very important in the sense that there should be transparency in the data analysis and interpretation. Credibility in qualitative research deals with how valid and believable the findings of the research study are, which is also referred to as internal validity (Bryman, 2016). Data were collected from participants through semi-structured interviews to ensure the credibility of this study. The participants were all asked the same questions, and their respective responses were captured verbatim in the field notes without any alteration. More so, the responses were

also audio-recorded for accuracy when transcribing them. I made sure that I did not influence the answers given by the participants towards their responses to the interview questions. In addition, a common observation sheet was used for all the participants when I was observing their lesson presentations. All these safeguards were considered in the study to ensure that the study report was credible, so the readers would be comfortable implementing the decision and recommendation made by the researcher (Tracy, 2013).

4.5.2 Transferability

Transferability in qualitative research can be described as the findings of a study which may apply to other contexts (Korstjens & Moser, 2018).

Transferability is otherwise known as external validity because the findings can be applied to other contexts, situations or groups by the readers (Ravitch & Carl, 2016). The concept of applicability is addressed by the concept of transferability. As a researcher, I provided an in-depth description of the participants involved in this study and the method used for the readers to determine whether my findings suit their context and situation as discussed in subsection 4.4.1. For, example, there were twelve Grade 10 science teachers teaching Life sciences who participated in this study. Each of the teachers was selected from one of the twelve secondary schools in the Ngwaritsi circuit, Sekhukhune South district, Limpopo Department of Education. The participation of these teachers was essential to this research study because they gave their perceptions regarding the importance of CPD programmes in improving their curriculum implementation.

4.5.3 Dependability

Dependability is ensuring that the research findings are dependable or consistent by giving the same results over a period of time if the same data collection methods are used (Billups, 2014). Dependability is otherwise referred to as the consistency of research findings over time (Korstjens & Moser, 2018). This means that other researchers can repeat the research study and produce the same results (Korstjens & Moser, 2018).

However, to ensure the dependability of qualitative data in this research study, I provided an in-depth description of the open-ended semi-structured interview results as well as the

lesson observation reports of the participants, thus, employing a suitable research method in ensuring the dependability of the data.

4.5.4 Confirmability

This is an aspect that deals with the fact that the result obtained can be confirmed by others or could be corroborated by other researchers by ascertaining that the research findings and results are the participants' true reflections and views and not just a permutation or imagination of the researcher (Korstjens & Moser, 2018). This is important because it reflects the accuracy and truthfulness of the participants' thoughtfulness; it also generates confidence in the results obtained (Billups, 2014). In confirmability, there should be no element of impartiality in the findings of a research investigation, the researcher should be neutral in the research finding and presentation of results (Moon, Brewer, Januchowski-Hartley, Adams & Blackman, 2016). However, in this current study, I ensure data is collected at three different schools (centres) from twelve Grade 10 science teachers teaching Life sciences. While I was trying to get the perceptions of the teachers' views towards the CPD programmes in the curriculum implementation, I made sure that I was not biased during the semi-structured interviews with the participants to avoid the contamination of the data. In addition, for the sake of reflexivity, during the semi-structured interviews process, I audio recorded the semi-structured interviews so that I could continuously refer back to the recordings and transcripts during analysis, therefore, ensuring objectivity was maintained.

4.6 ETHICAL CONSIDERATIONS

Research ethics focuses on the procedures that guide a study; this includes professional codes of conduct, moral rules to collect data, analyse it, and reporting and publishing information about study participants (Vuban & Eta, 2018). Research ethics was established as a set of guiding principles to help researchers conduct ethical investigations (Johnson & Christensen, 2014).

Researchers should consider any of the ethical issues which may negatively affect the research process and they should establish what the study about is to ensure that it does

not harm the participants (Msimanga, 2017). Ethical procedures and principles also assist researchers to avoid possible abuses and define their responsibilities as researchers.

The University of South Africa has established an ethics review committee, the College of Education (CEDU) convenes to discuss each of the projects before the data collection process begins. The decisions reached by CEDU committee may result in the approval or be referred for corrections or to be disapproved with reasons. The CEDU committee has laid down requirements, and each project must meet the requirements before the issuance of an ethics clearance certificate giving the researcher permission to commence the data collection processes. The ethical clearance certificate is attached as *Appendix A,* with a reference number 2021/02/10/49254103/13/AM.

I took the following ethical procedures into consideration during fieldwork, namely: informed consent, confidentiality, privacy, anonymity, no harm or risk to participants and avoidance of deception.

4.6.1 Informed consent

Informed consent is a process whereby a person purposefully, voluntarily and intentionally gives their consent to participate in a study (Shamoo & Resnik, 2015; Resnik, 2015). Guest et al. (2013), further say that informed consent may mean revealing and explaining major aspects of the research and collection of data to the prospective participants. The participants who voluntarily agreed to participate in the study will be requested to complete and sign the consent letter or form designed and prepared by the researcher. Tulyakul and Meepring (2020) also support the view that there should be a voluntary agreement between the researcher and the participants in a research study. However, I gave the participants the consent forms, which each of them signed and returned to me before the commencement of the interviews. Furthermore, according to the UNISA ethics code, I wrote a letter of permission to the Limpopo Department of Education (*Appendix B*), and the permission was granted *(Appendix C)*. In this vein, a letter of permission was similarly sent to Ngwaritsi Circuit Manager to access the selected secondary schools (*Appendix D*); the permission was also granted *(Appendix E*).

4.6.2 Confidentiality, privacy, and anonymity

The privacy of the participants who participate in the research study is very critical. Participants become more confident and willing to participate when they are informed that their responses will be kept secret and not be disclosed. Therefore, confidentiality is the act of making sure that any personal information given by a participant in a research study is not transferred or provided to any other person that is not involved in the project (Antioch University New England, 2010; Resnik, 2015; Shamoo & Resnik, 2015). There is always an agreement between the researcher and the participants about the information provided in the research study on what should be done with it (Johnson & Christensen, 2014). The participants can inform the researcher of the information that can be kept or not. In addition, anonymity is a way of ensuring that individual responses or results in a research study are not directly connected to the participants and the data obtained are without any personally identifiable information (Antioch University New England, 2010; Resnik, 2015).

To ensure that issues regarding confidentiality and anonymity are enforced and strictly adhered to in the research study, I ensured that a specific participant's responses were not divulged to any other individuals or participants. In addition, I made sure that there were no names, addresses or any information in the interview responses and observation sheet which could be used to identify any of the participants in the study. In conclusion, all the audio recordings of the participants' semi-structured interview responses were saved on my personal computer and encrypted with a password.

4.6.3 No harm or risk to participants

It is compulsory and mandatory that the researcher ensure that all the volunteers in a research study feel safe and protected, ensuring they will not be put at any risk or harm. According to Leavy (2017), the major standard of upholding the protection of a research study is to make sure that it is not inflicting harm or risk on participants or volunteers. This is the basis and vital concepts governing research ethics. Whilst applying for my ethical clearance from UNISA's CEDU ERC (College of Education Ethics Review Committee) to conduct a research study, there is a portion in the application form wherein the researcher

must indicate any hazard, harm or injury the volunteers or participants may be exposed to. Fortunately, regarding my research study, there is no danger of hazard, injury or harm to the participants, including bodily, psychological, or emotional harm. The participants (Grade 10 sciences teachers teaching Life sciences) were interviewed at a conveniently scheduled time agreed between them and me. The interview sections, lesson presentations and CPD interventional workshop took place during normal school hours. There was no extra time spent by them after school hours.

4.6.4 Avoiding deception

Deception, i. e. lying to the participants about the true nature of the research study by the researcher, should be avoided. Salkind (2012:37) says, "*If deception is involved as part of the research, then all participants must be debriefed following the experiment or the session in which deception took place*." This means that the research process will be compromised in the case of deception, or the participants will not be free to provide honest responses. I made sure that my study did not involve any form of deception. I informed all the participants before the commencement of the research study about the nature of the study and how it would be conducted.

4.7 CHAPTER SUMMARY

This chapter focused primarily on the research design and method. The chapter discussed the research population, sampling procedure, and data collection methods. The population included twelve Grade 10 science teachers teaching Life sciences who were selected from twelve secondary schools in the Ngwaritsi circuit, Sekhukhune South, Limpopo Department of Education. Data for the study were collected from these science teachers through open-ended semi-structured interviews and lesson observations, which took place before and after a CPD programme interventional workshop. Finally, I discussed the issue of ethical considerations in detail in this chapter, such as informed consent, confidentiality, privacy, anonymity, no harm or risk to participants and no deception. In the next chapter, Chapter 5, I will present data analysis and interpretation of the research study findings.

CHAPTER 5

DATA ANALYSIS AND INTERPRETATION

5.1 INTRODUCTION

The main aim of this study was to explore and establish the Grade 10 science teachers' perceptions of CPD programmes as support for an intervention to improve their curriculum implementation and to propose a model to illustrate the use and advantages of CPD programmes or activities.

This chapter presents the data analysis and discusses the research findings reports to answer both the primary and secondary research questions, respectively, as stated in Chapter 1, subsections 1.5.1 and 1.5.2. The data were collected through semi-structured interviews and lesson presentation observations from Grade 10 sciences teachers teaching Life sciences to establish their perceptions regarding CPD programmes as an intervention to improve their curriculum implementation.

The findings obtained from the empirical data from participants are analysed, compared, interpreted against literature, and discussed in this chapter.

5.2 RESEARCH PROCESS

Before the data were collected, I ensured strict adherence to the ethical guidelines regarding the research study. I met all 12 Grade 10 science teachers teaching Life science in a school within the circuit on the agreed time and date because I had communicated and made an arrangement with them earlier. I discussed the research study and its ethical issues with them. Furthermore, we discussed how to observe the COVID-19 protocols. It was also agreed for convenience's sake that three schools should be chosen as centres where the interviews and lesson presentation observations would take place. These schools were chosen as centres based on school performance and proximity because most of the other secondary schools in the circuit were not closer to one another. The problem is that most of the schools in rural areas are far from each other despite being within the same circuit. The participants were very cooperative and happy with the research process as outlined and planned. The study's data collection

method was divided into three phases: pre-semi-structured interviews and lesson observations, CPD programme interventional workshop and post-semi-structured interviews and lesson observations.

5.2.1 Process of semi-structured interviews

To explore and establish the perceptions of the Grade 10 sciences teachers regarding CPD programmes as an intervention in improving their curriculum delivery, I conducted semi-structured interviews with each participant in their respective centres according to the agreed dates and times. During the pre- and post-interviews, I asked the participants questions to understand their experiences teaching the Grade 10 Life sciences subject and how they delivered the curriculum. Twelve Grade 10 science teachers teaching life sciences were chosen, each representing each of the 12 secondary schools in the circuit.

I used the prepared interview guide sessions with the participants and Grade 10 science teachers teaching Life sciences (*Appendix H*). A voice recorder was used to record the participants' responses during the pre- and post-interviews, respectively. I sought permission from the Limpopo Department of Education, the Ngwaritsi Circuit Manager and Grade 10 sciences teachers teaching Life science, which were granted before the interviews could be conducted. I reiterated the content of the consent letters, indicating that the information gathered from the participants (Grade 10 science teachers teaching Life sciences) would be kept strictly confidential. They were further informed that their participation in the study was completely voluntary and that they were not compelled to do so. In addition, I told them they have the right to withdraw at any time without prejudice. I spent thirty minutes interviewing each of the participants, and the interview conversations were noted and recorded.

5.2.2 Process of lesson observations

There were lesson presentations by the 12 participants (Grade science teachers teaching Life sciences), and I observed each lesson presentation using an observation sheet (*Appendix I).* The pre-lesson observations came up after the pre-interviews to assist me in deciding what kind of CPD intervention programme to design and plan for the participants as an intervention to their curriculum challenges.

The challenges identified by each participant during the pre-interviews and the observations of their lessons presentation helped me design and plan a CPD programme that addressed all the challenges to improve their classroom practices or curriculum delivery.

The post-lesson observation happened after the intervention CPD programme. The participants presented their lessons individually, and I observed using the same observation sheet. The main objective was to see whether the intervention worked or not and to examine whether the CPD intervention programme addressed the identified challenges the participants faced. I used an observation schedule sheet designed by me to observe the participants during both the pre- and post-lesson presentation.

Above all, I observed each participant for thirty minutes according to the allocated time for their lesson presentation during the pre- and post-lesson presentations, respectively.

5.2.3 Continuing Professional Development programme intervention workshop

The CPD programme intervention workshop took place two months after the pre-semi-structured interviews and pre-lesson presentation observations of the 12 participants. Both the pre-semi-structured interviews and pre-lesson presentation observations assisted me in designing and planning a CPD programme that addressed the participants' challenges mentioned in the pre-structured interviews, which I also observed during the pre-lesson presentation observations. This interventional workshop lasted for two days. During the workshop, the teachers interacted and collaborated, exchanging ideas, wherein I played the role of a facilitator and mentor to the participants.

5.3 DATA ANALYSIS

Dada analysis is a procedure used in research to answer the research questions raised in a study, which includes organising, categorising, altering, and summarising data. Normally, this is always the first stage of the data interpretation process.

Therefore, qualitative data analysis is adopted in this study which involves organising data into categories, identifying patterns and varying the relationship among categories (McMillan & Schumacher, 2010). However, from an interpretative point of view, data

analysis in this study aimed to report on, describe and interpret the reflections of Grade 10 science teachers' perceptions of a CPD programme as an intervention in improving their curriculum implementation. The research participants were Grade 10 science teachers teaching Life sciences, and data were collected from them for analysis through interviews and lesson observation.

Nevertheless, I followed the steps in analysing as outlined by Vaismoradi et al. (2016) in analysing my data:

1. First and foremost, I read through the data collected and made sure that I familiarised myself with the most important concepts. This data familiarisation was followed by transcribing the data gathered through the interviews (pre- and post-interviews).

2. I revised the study research questions once again as stated in Chapter 1. Subsequently, I was able to gather some information which can provide answers to the questions.

3. Above all, I tried to identify the concepts, phrases, behaviours, and participants' thoughts as expressed in the data. I, therefore, assigned codes to them to develop a framework.

4. Immediately after coding the data, I searched for the most frequent themes emerging from the responses or replies to the questions, to discover the data or patterns that could best can answers the research questions formulated.

5.3.1 Biographical data of participants

The biographical data of the twelve Grade 10 sciences teachers teaching Life sciences who participated in the semi-structured interviews and lesson presentations are shown in Table 5.1. For the sake of ethical issues, the names of the participants are not mentioned but are represented by the letter 'T' and a number, which stands for teacher, according to the name given to the subject teachers by the Department of Basic Education.

Table 5.1: Biographical data of participants

Participants	Teaching experience	Gender	School performance
T1	6 years	Male	Above performer
T2	4 years	Female	Above performer
T3	6 years	Female	Above performer
T4	8 years	Male	Average performer
T5	5 years	Male	Average performer
T6	2 years	Female	Average performer
T7	3 years	Male	Average performer
T8	4 years	Male	Below average performer
T9	2 years	Male	Below average performer
T10	1 year	Female	Below average performer
T11	3 months	Female	Below average performer
T12	3 weeks	Male	Below average performer

5.3.2 Research analysis

In the next sections, data obtained from both pre- and post-semi-structured interviews are presented and discussed according to the headings as reflected in *Appendix H* and *Appendix J,* respectively. Both the pre- and post-lesson presentation observation reports of the participants are equally presented and discussed in this section *(Appendix I*).

The responses of the 12 participants in both pre-and post-semi-structured interviews were classified into themes separately to provide explanations and answers to the research questions.

5.3.2.1 Analysis of pre-semi-structured interviews and pre-lesson observations

This section presents and discusses the responses to the questions answered by the 12 participants (Grade 10 science teachers teaching Life sciences). I will also discuss my observations during the pre-lesson presentations of the 12 participants.

(i) Semi-structured pre-interviews

The data from the pre-semi-structured interviews were aimed to assist me in planning and designing an intervention of a CPD programme that addresses the challenges identified in the participants' responses.

1. What do you want to teach?

When the participants were asked this question, they said they would be teaching '*Organic Molecules'*. Fortunately, this is the topic that the Grade 10 science teachers teaching Life sciences should be teaching during that period according to the subject's pacesetter. In addition, all the participants mentioned the content area they would be focusing on when teaching this topic. For example, two participants responded by saying that:

> "*I will be teaching organic molecules and I will talk about proteins and enzymes" (T2).*
>
> *"I will be teaching organic molecules and laying emphasis on protein and enzymes" (T3)*

2. How will you teach it?

Regarding this question, the participants were expected to explain the teaching method and teaching strategy they would use during the lesson presentation.

However, ten participants responded that they would be using the textbook and chalkboard to teach the learners and using face-to-face learning as an instructional method. None of the participants mentioned the teaching strategy they might adopt or use. Although, two other participants buttressed their responses to this question and explained why face-to-face learning as an instructional method would be used. Their responses were as follows:

> *"I will be teaching by giving notes to the learners because we do not use technology in the school. I will teach the learners, and they will take notes. The teaching was done face-to-face" (T1).*

> *"I will be using a learner-centred approach. The learners will be more active. The CAPS aligned to learner-centred approach. Because we don't have a laboratory, I will use textbook and chalkboard" (T3).*

3. How long have you been teaching the subject?

This question was asked to establish their teaching experience in the subject. The participants' responses varied. The teacher with the longest experience has eight years, while the shortest has 3 weeks. Table 5.1 depicts the number of years of teaching experience of each participant.

4. Do you specialise in the subject?

Specialisation in a subject taught by a teacher may broaden the teacher's content knowledge and understanding. The teacher may have a good teaching method and strategy which can be used appropriately to enhance effective delivery of the subject curriculum.

Regarding this question, nine participants responded that they specialised in the subjects, but three participants said they did not specialise in the subject. Their responses included:

> "*I specialised in Physical sciences and Mathematics" (T8).*

> *"I specialised in Agricultural science" (T9).*

"No, I specialised in Mathematics but asked to teach it" (T11).

5. Do you encounter any challenges in teaching the subject, motivate?

I was interested to know whether the participants who teach this subject encounter any challenges in teaching the subject. Furthermore, I also wanted to know if the challenges encountered were only peculiar to the teachers who did not specialise in the subject or whether it affected both teachers that specialise and those that did not specialise in the subject.

However, all 12 the participants responded to this question that they encountered challenges in teaching the subject. These responses mean that whether they specialise in the subject or not, they all encounter challenges in teaching it.

For example, a participant said,

> *"Ha! Lots of problems, I teach in an overcrowded classroom coupled with no teaching resources" (T3)*
>
> In addition, two participants who did not specialise in the subject responded to this question as follows
>
> *"Yes, many challenges are there in Life sciences. For example, I did not specialise in the subject; therefore, I have limited content knowledge" (T8).*
>
> *"Hmm, Yes! I do experience many challenges in teaching this subject; more so, there are no teaching resources at all" (T9).*

What are the challenges you encountered in delivery the content?

The participants mentioned the challenges they encountered in delivering the curriculum in this subject. The reason for asking this question was to understand the problems or challenges the teachers faced. This question assisted with the type of CPD programme intervention designed for them.

The challenges identified by the 12 participants can be summarily divided into four parts: 1. Non-availability of resources, such as a laboratory, practical equipment, internet, projector, and textbooks. 2. A. strategy to teach science vocabularies and terminologies to the understanding of the learners. 3. The usage of the English language as the language of teaching and learning without code-switching. 4. Pedagogical content knowledge and subject matter content.

The following are some of the participants' responses to this question.

> "*We do not have a laboratory to perform experiments. The learners struggle with English language" (T3)*
>
> *"There are insufficient teaching resources such as, a science laboratory, internet, etc." (T4).*
>
> *"The challenges ranges from completing the syllabus, we do not have a laboratory to perform practical. There are some contents I do not understand myself, I lack strategy to teach some contents" (T6).*
>
> *"Life sciences is more theoretical with many terminologies and vocabularies. It is difficult to get the exact words for the learners in Sepedi. I find it difficult to explain the meaning to them in Sepedi. There are no laboratory and materials to perform practical" (T8).*

6. Do you receive support and assistance on the challenges encountered in delivering the content, motivate?

The main reason for this question was to find if the participants received or have been receiving support towards the challenges they encountered in delivering the curriculum.

Nevertheless, the 12 participants responded that they never had any support or that the support did not meet their expectations. Eight participants said the workshop organised for them did not assist in any form. For example, these are the responses of two participants:

> *"No support! Whenever I attended a workshop is only content based, and it*

only took place in year 2016. We do need workshops to assist us because we do not have many workshops" (T1).

"I do not receive any support whatsoever. I had to struggle by myself. Most of the organised workshop do not address the problems we do have. I don't know how they organise such programme" (T3).

In addition, two participants responded that despite their complaints, they still did not receive any support.

"Never! I do not receive any support in spite of me complaining" (T7).

"Yoyoyo! Meneer! That is a capital NO! I'm on my own" (T9).

7. Which part of the subject curriculum do you need support and training in?

This question was posted to enable me to understand the kind of support the participants needed. It also assisted me in designing an intervention which can address their challenges.

However, the participants outlined the various areas in which they need support and assistance. For example, some participants said they needed support on the strategy to teach practical aspects. Furthermore, some participants said they needed content knowledge in certain topics, while many others needed support on a strategy to teach science vocabulary and terminology to the learners, especially since they speak English as a second language. Above all, almost all the participants want to know the strategy they can use to teach learners who speak English as their second language. These are the responses of some of the participants to the question:

"The strategy of teaching Life sciences to learners who are not fluent in English" (T1).

"I need support on how to explain and teach the learners to understand the vocabularies and terminologies. Again, there are some topics that are problematic to me. I will need content workshop" (T9).

"I will need on the strategies to teach English second language learners, also I need more content knowledge in organising practical investigation" (T10).

(ii) Pre-lesson observations

Pre-lesson observations occurred during the first lesson presentations by the 12 participants (Grade 10 sciences teachers teaching Life sciences). An example of a participant pre-lesson observation sheet is attached to *Appendix K*. As I have indicated earlier, an observation sheet with listed criteria was used. I shall summarise and discuss the observations of the 12 participants' first lesson presentation regarding each of the criteria listed in the observation sheet. The pre-lesson observation was to assist me to see where to improve or assist the participants in their classroom practices, and it will also guide me to design an effective interventional workshop aimed to address the participants' (teachers') challenges.

a) Use of instructional language

I observed that five out of the 12 participants only used the English language throughout their lesson presentations, while the other seven participants used both the English and Sepedi languages respectively. It was observed that these seven participants sometimes code-switched to the Sepedi language to explain some concepts to the learners for better understanding.

b) Subject content knowledge

I was interested to know whether the participants knew the subject content well. It was observed that not all the participants knew the subject content, especially those who did not specialise in the subject. Moreover, I observed that some participants with less than three years of teaching experience in the subject also struggled to deliver the subject content effectively.

c) Teaching strategy

I observed that the 12 participants used a face-to-face instructional method, whereby the participants (teachers) read from the Grade 10 Life sciences textbook and explained to

the learners. They write some important concepts or vocabulary on the chalkboard. It was observed that none of the 12 participants observed by me used any particular teaching strategy during their lesson presentations.

d) Lesson is aligned with CAPS policy

The lesson presented by the participants was aligned with the CAPS policy because the topic was taken from the Grade 10 Life sciences syllabus as contained in the CAPS policy document. Furthermore, according to the subject pacesetter, the topic must be taught in term two, week five. According to the CAPS policy, the topic specifically addresses aims one and two, respectively.

e) The developmental flow of the lesson

During their lesson presentations, I observed that the participants commenced the lesson by introducing the topic to the learners. In addition, it was observed that participants in their individual classes started explaining the content to the learners from abstract to concrete, even though it was observed that some participants were struggling with the content knowledge.

f) Learners' involvement and participation

I observed that the learners were not participating as expected when I observed each participant's lesson presentation. This observation was more noticeable in the classes of five participants who stuck only to the English language while teaching the learners. The learners were unable to ask or answer any questions. However, this was different in the classes of the other seven participants because the participants code-switched into the Sepedi language to explain the content of the topic to the learners. I, therefore, observed that the learners were better involved and participated in the lesson. The learners asked and answered almost all the questions in the Sepedi language.

g) Use of learning and teaching support materials (LTSM)

I observed that none of the 12 participants used any other learning and teaching support materials (LTSM) apart from the Grade 10 Life science textbook, chalks and blackboard.

There were no other LTSM used by the participants during their individual lesson presentations.

h) Flow of classroom communication

During the lesson presentations by each participant, I observed that in classrooms of five participants, the communication was only a one-way flow. The communication only flowed from them to the learners, whereas the learners were not engaged interactively. There was no communication flow or interaction between the participants (teachers) and the learners. Nevertheless, I observed communication flow and interaction between the seven participants and their learners during the lesson presentations. I noticed this happened whenever any of the seven participants code-switched to the learners' mother tongue, Sepedi.

i) Classroom management

All 12 participants were able to manage their classrooms during the lesson presentations. I observed that the classroom seating arrangements were in order, and there were no disturbances from any learners during the lessons.

j) Time management

I observed that three out of the 12 participants could complete their lesson presentations within thirty minutes allocated to each participant to present their lessons. The remaining nine participants could not complete their lesson presentations within the stipulated and allocated time.

5.3.2.2 Post-semi-structured interviews and post-lesson observations

It should be noted that post-lesson observations took place before post-semi-structured interviews, as explained in Chapter 4, Sub-section 4.4.2 under 'process of data collection involving Participatory Reflection and Action' in phase three: activities after CPD programme intervention workshop. It was important that the participants presented their lessons (post-lesson) after the CPD programme interventional workshop before they were interviewed (post-semi-structured interviews) because it enabled me to combine what I

observed during their post-lesson presentations and their responses during the post-interviews.

The post-lesson presentation observation report and answers to post-interviews by the 12 participants (Grade 10 sciences teachers teaching Life sciences) were presented and discussed as follows:

(i) Post-lesson observations

The post-lesson observations which occurred after the 12 participants' (Grade 10 sciences teachers teaching Life sciences) CPD programme interventional workshop are discussed in this section. The workshop lasted for two days; after that, the participants returned and were asked to present their lessons individually in each of their centres. Again, each participant's lessons were observed using the lesson observation sheet (see *Appendix I*). The post-lesson observation aimed to establish whether or not the CPD intervention workshop worked. I shall therefore discuss what I observed during the participants' lesson presentations in reference to each criterion in the observation sheet.

a) Use of instructional language

I observed that all 12 participants used the English language (the instructional language mostly used in South African schools) during the lesson presentations in their classrooms. The seven participants that code-switched during the pre-lesson presentation all improved in explaining the concepts to the learners in the English language. I observed that those seven participants tried to adhere to the usage of the English language, but they had to code-switch to Sepedi in a few instances to explain a few concepts to the learners.

b) Subject content knowledge

During my observation of each participant's lesson presentations, I observed that they demonstrated an appropriate understanding of the subject topic presented to their learners in their respective classrooms.

c) Teaching strategy

Unlike the pre-lesson presentation by each of the 12 participants, where none used or demonstrated any teaching strategy, I observed that the participants used different teaching strategies during their lesson presentation, such as peer-led team, inquiry-based learning and cooperative learning.

d) Lesson is aligned with CAPS policy

The lesson presented by the participants after the CPD intervention workshop was aligned with the CAPS policy. According to the CAPS policy document, this topic was chosen from the Grade 10 Life sciences syllabus. According to the subject pace setter, this topic must be taught in Term 2, Week 3. According to the CAPS policy, the topic specifically addresses Aims 1 and 2.

e) Development flow of the lesson

I observed that each participant gave a clear and effective introduction to the lesson. The participants showed they had sufficiently prepared for the lesson, which ran smoothly. Furthermore, it was observed that in their respective classrooms, each participant closed the lesson presentation appropriately and summarised the lesson.

f) Learners' involvement/participation

When I observed these participants during their individual lesson presentations, I saw that the learners were involved and participated in the lesson. The reason was that the participants used teaching strategies that enabled the involvement and participation of the learners. I observed that some participants used cooperative learning while some used inquiry-based learning.

g) Use of Learning and Teaching Support Material (LTSM)

The participants demonstrated competence in the use of teaching materials. All 12 participants still used chalk, a blackboard, and the Grade 10 life science textbook. Moreover, I observed nine participants that used additional teaching and learning support materials such as eosin, a glass jar containing water, a plant (soft plant), a razor blade and a microscope.

h) Flow of classroom communication

I observed that there was a free flow of classroom communication between each of the participants and their respective learners during the lesson presentations. I observed interactions between each of the participants and their learners in classrooms. In some instances, the learners asked questions, and the concerned participant provided answers. I also observed that the participants posted some questions for their learners to answer. These activities promoted the communication flow and interaction between the participants and their learners.

i) Classroom management

I observed that all 12 participants controlled and managed their classes effectively during the lesson presentation. They organised their classes very well, and even when the learners were involved in group discussions, there was no disorganisation or rowdiness by the learners.

j) Time management

I observed that 11 out of the 12 participants could finish or complete their lesson presentation according to the thirty-minute allocated time. Only one participant could not complete the lesson presentation within the allotted time.

(i) Post- semi-structured interviews

The post-interviews took place after post-lesson presentations and observations of the 12 participants. The purpose of the post-semi-structured interviews was to establish the participants' views towards the interventional CPD programme and to find out whether it improved their curriculum delivery and implementation. The post-semi-structured interviews provided answers to the research question and research sub-questions.

1. What is your view towards the interventional workshop?

This question aimed to establish the participants' views pertaining to the CPD interventional workshop I designed for them.

The 12 participants responded with almost the same views. According to their responses, they were happy with the intervention. They all agreed that it was very helpful to them since they acquired more knowledge from the CPD interventional workshop. In addition, seven participants said they gained knowledge and skills from their other colleagues when working together.

The following are examples of the responses of the participants regarding their views towards the interventional workshop:

> *"The intervention was so helpful to me personally" (T5).*
>
> *"The intervention was highly superb. Highly educative and rich in knowledge, especially working together with colleagues" (T7).*
>
> *"The interventional programme was well planned. I learnt from other colleagues. I saw the advantage of working and sharing views together" (T9).*

2. Does the CPD intervention programme address your curriculum challenges?

I am highly interested to know whether the intervention worked or not since previously, in the pre-semi-structured interviews, almost all the participants said that even if a CPD workshop was organised for them, it did not address their challenges. Therefore, I needed to know if the interventional programme solved their challenges.

However, when each participant was asked this question, their responses were almost identical. They all answered that the intervention worked effectively for them. For example, a participant said the following;

> *"I learnt lots of things, and I saw an improvement in my classroom during my lesson presentation to my learners" (T2).*

In buttress to the fact that the intervention worked effectively, another participant indicated that:

> *"The intervention worked very effectively because it addresses my problems in the subject" (T4).*

3. What are your perceptions towards CPD programmes as a science teacher?

This question is very critical because it will, amongst others, assist in providing practical answers to the research question. The 12 participating Life sciences teachers responded when I interviewed them individually that CPD programmes are very important and needed in their subject curriculum, especially to deliver an effective curriculum. Some participants' responses clearly stated that the CPD programmes should be well planned in line with their needs to address their challenges as science teachers. The responses of the participants were as follows:

> *"My views towards CPD is that the programme is highly needed by us the science teachers. We struggle a lot alone, in most instances there are no mentorship. I have seen from the programme now that we can learn from each other" (T5).*
>
> *"It is my belief that science teachers need CPD programmes because of the new discoveries in science and technology. For every teacher to be abreast with more knowledge CPD will be needed" (T6).*
>
> *"CPD programme is very essential for all science teachers, more importantly for those who don't specialise in the subject they teach because they struggle" (T8).*

4. Do you think CPD programmes are needed to enhance your curriculum delivery in your science subject?

In the quest to establish the participants' views of CPD programmes, I am interested to know whether science teachers will need the CPD programme to enhance the curriculum delivery and implementation of their science subject.

The 12 participants responded individually that the CPD programmes are highly needed to enhance their curriculum delivery and implementation in the subject. Among the challenges they mentioned that necessitated CPD was the country's education curriculum changes. They all believed that CPD would assist them in acquiring the necessary

knowledge to deliver new curricula whenever they are introduced for implementation. The following are examples of the responses:

> *"Exactly, CPD programmes will enhance my curriculum delivery, we all need knowledge and more understanding especially with curriculum that is changing time and time in this country" (T1).*

> *"The country has been experiencing curriculum changes, the CPD is needed in order to upgrade the teachers to new expected standard of knowledge and skills required to deliver the curriculum" (T9).*

5. Do you think, as a science teacher, a CPD will have an impact in your subject curriculum?

In response to this question by each of the 12 participants, they vehemently agreed that a CPD programme, if well planned and if they were consulted before it was designed, would definitely have a positive impact in enhancing their curriculum delivery, especially because of the constant changes in the country's education curriculum. In addition, they said it would positively impact their curriculum delivery if it is designed to address all the challenges they are experiencing in the subject curriculum.

Examples of the participants' responses include:

> *"Yes, the more I will have CPD programmes in my subject the more it will have a positive impact in me. Unfortunately, we often not have these workshops. We are left without support, hence it had negative impact on me" (T1).*

> *"CPD will definitely have a positive impact in the subject curriculum delivery if the design of the CPD programme is planned in such a way that it caters for our challenges and problems" (T7).*

> *"According to my view as a science teacher, CPD will have a positive impact in my subject curriculum if it is well planned and we are consulted before any CPD programme is designed for us" (T8).*

6. How often do you think CPD programmes should be conducted?

The responses of the participants to this question differed. Even though they all indicated that it is important to conduct the CPD programme often, they gave different time frames. The majority of the participants said they wanted the CPD programme to be conducted once a month, some said it should be conducted twice or thrice in a term, while only one participant said it should be conducted twice in a month, but a participant also indicated that it should be conducted at least once in a term. In a nutshell, all 12 participants want the CPD to be conducted frequently. The following are some of the participants' responses to the question:

> *"I think this programme should be done at least once in a month. We need it greatly, especially for the new recruited teachers" (T*1).
>
> *"I personally propose once or twice in a term" (T4).*
>
> *"As a new teacher, I need it every month" (T12).*

5.3.3 Themes and categories of pre-semi-structured interviews and post-semi-structured interviews

Themes are developed from data for further analysis of the codes and descriptions (Okeke & van Wyk, 2015). A category is the gathering of associated data arranged into the same location by researchers recognising and characterising the category's properties (Morse, 2018). It is, therefore, essential to know that themes are described through categories.

Nonetheless, the data I derived from pre- and post-interviews were analysed from my notes and taped scripts. I followed and adopted the steps of data preparation as outlined by McMillan and Schumacher (2010) in the following manner:

- Collection of data: I used the interview schedule I prepared to collect data.
- Organisation of data: Data collected from each participant through semi-structured interviews were sorted according to the themes.

- Transcribe data segments: I summarised the semi-structured interviews as written in the research dairy. In addition, the interviews were audio-recorded and transcribed later.
- Code data: I recognised the thoughts that stood out and analysed them to create codes. I compared them so as not to duplicate codes.
- Data categorisation: I put similar codes together and arranged the main thoughts into categories.
- Development of patterns: I developed the patterns in the data by identifying the relationships between categories.
- Writing of findings: The data were presented in suitable figures, graphs, tables, and diagrams, and after that, I commented on the data.

The themes derived from pre-semi-structured interviews and post-semi-structured interviews are presented in Tables 5.2 and 5.3, respectively.

Table 5.2: Themes and categories of pre-semi-structured interviews

Themes	*Categories*	*Code*
1.Subject specialisation	• Life sciences • Mathematics & Physical sciences • Mathematics • Agricultural sciences	• Qualification
2. Teaching and learning support materials	• Life sciences textbook • Chalk	• Teaching aids

(LTSM)	• Blackboard • Projector • Photocopying machine • Computer	
3. School infrastructure	• Classrooms • Science laboratory • Library	• Resources
4. Language of the subject	• English language • Sepedi language	• Language
5. Professional support	• Subject content knowledge • Teaching methods/ strategies • Pedagogical content knowledge	• Science subjects curriculum

Table 5.2 summarises the themes and supporting categories that arose from the pre-semi-structured interviews of the participants (Grade 10 science teachers teaching Life sciences). The empirical findings exposed the teachers' challenges in implementing and delivering the science curriculum effectively and why support is required. These challenges raised by the participants and with the support needed were discussed in detail in the next section.

Table 5.3: Themes and categories of post-semi-structured interviews

Themes	*Categories*	*Code*
1. Sciences teachers	• Life sciences teachers • Mathematics & physical sciences teachers • Mathematics teachers • Agricultural sciences teachers	• Subject teachers
2. PD as intervention to improve curriculum delivery	• Curriculum policy • Curriculum of the subject • Teaching methods/ strategies • Curriculum approach	• Curriculum changes
3. CPD programmes/ activities design	• Training • Mentorship • Seminars • Conferences • Courses • Qualification programmes	• Professional support

Table 5.3 summarises the themes and supporting categories derived from the participants' (Grade 10 science teachers teaching Life sciences) post-semi-structured

interviews. The empirical findings revealed the participants' perceptions of CPD programmes as an intervention and how it improved their curriculum implementation and mitigated their curriculum challenges. These findings are extensively discussed in the next section.

5.4 DATA INTERPRETATION

The data interpretation of this study is anchored by the theoretical framework which provided explanations to the empirical findings of Grade 10 science teachers' perceptions of CPD programmes as an intervention to improve curriculum implementation.

After the presentation of data for analysis, it is imperative to interpret the data for the researcher to draw conclusions emanating from the data that have been collected and analysed, thus comparing the findings with the conclusions of the findings by other researchers (Letshwene & du Plessis, 2021). Therefore, the analysis of data collected from both pre- and post-semi-structured interviews was presented in the form of themes and categories. The themes were interpreted in reference to the summarised observations of the participants' pre-lesson presentation and post-lesson presentation to provide answers to the research questions and relate them to the theory and literature findings.

It is important to note that each of the themes in Tables 5.2 and 5.3 were formulated to possibly represent the questions presented to participants during the interviews. These themes should not be seen as independent or definite, but they are intended to be adjunct or imbricate. Nonetheless, the semi-structured pre-interviews and post-semi-structured interviews were transcribed and grouped into headings of themes, as indicated in Tables 5.2 and 5.3, respectively. However, the discussion of these findings is presented in the following sections.

5.4.1 Interpretation of data of pre-semi-structured interview themes

Five themes were derived from the analysis of data collected through pre-semi-structured interviews. The themes are discussed in the following section.

5.4.1.1 Theme 1: Subject specialisation

Teachers who teach a particular subject need the required qualification and must also specialise in their subject to deliver and implement proficient subject content. Teaching Life sciences requires teachers to specialise and have relevant qualifications. It is evident that some schools do not have teachers specialising in the subject they were employed to teach; the school management assumes that as much as a teacher has a qualification in a particular science subject such teacher can teach any other science subject. This assumption is clearly wrong because the subject contents and curricula differ. Furthermore, some schools just impose the subject on the teachers to teach whether they specialise in it or not. This factor will strongly affect the curriculum implementation of the subject teacher. This assertion is supported by Mizzi (2013) and Netshivhumbe and Mudau (20121), who say that teachers teaching outside their specialisation area face different challenges in the subject. Many of them lack confidence which leads to an inability to deliver and implement an effective curriculum because of their poor content knowledge in the subject (Chapter 2, Section 2.8).

It was very clear in the study that participants who do not specialise in teaching Life sciences complained about teaching it as they struggled to present lessons in their respective classrooms. From my personal experience, teachers who do not specialise in the subject they teach deliver poor subject content; they also do not possess the knowledge and understanding required to teach the subject effectively (Alebous, 2021). Many of them only teach the topics they are comfortable with, which harms the learners' academic performance.

5.4.1.2 Theme 2: Learning and teaching support materials (LTSM)

For an effective curriculum delivery in the science classroom, learning and teaching materials (LTSM) should be provided and made available to both the teacher and learners. Non-availability of learning and teaching support materials was identified as one of the challenges by the participants. All the participants in this study alluded to the fact that their curriculum delivery in the subject of Life sciences is hampered by a lack of learning and teaching support materials such as projectors, computers, science kits,

access to a photocopying machine, etc. The CAPS was introduced to mitigate the effects of challenges teachers face in implementing RNCS, but unfortunately, this is not the case, especially in rural schools in rural areas. Majharaj et al. (2016) and du Plessis and Mestry (2019) attribute the non-availability of LTSM as one of the challenges teachers encounter in the delivery of the CAPS curriculum (Chapter 2, Section 2.8). A report by the Ministerial Committee on Rural Education (2005) noted that among the challenges the teachers in rural schools face is the non-availability of LTSM (Chapter 2, Section 2.8).

It was obvious that all the participants in this study only used chalk, a blackboard and a life sciences textbook as their LTSM. These materials are not enough to be used in science classrooms, especially in a subject that demands practical experiments to be performed. It is the view of du Plessis and Mestry (2019) that under-qualified science teachers rely only on textbooks to teach and refuse to do a practical investigation with the learners even with the availability of laboratories at their schools, but this is not the case in the schools in rural areas. Many schools in rural areas do not have laboratories in their schools. The participants' schools do not have a laboratory at any of the schools and were not supported with any other learning and teaching support materials. From my experience, this might affect the implementation and hinder curriculum delivery.

5.4.1.3 Theme 3: School infrastructure

When Curriculum 2005 was introduced to South African schools, it was reportedly faced with several challenges in its implementation, and one of the problems was the lack of infrastructure. School infrastructure, such as laboratories, classrooms, libraries and administrative offices, is vital for schools to possess because it aids the delivery of an effective curriculum. Even after Curriculum 2005 was restructured and redesigned to give way to the CAPS, school infrastructure is still a major problem, especially in rural schools. This assertion agrees with Michael Gardiner (2008), who said that many rural schools lack basic infrastructure, which will affect the quality of science education (Chapter 2, Section 2.8).

Almost all of the participants in this study said that laboratories and libraries are part of the infrastructure that will assist them in teaching and delivering the science curriculum

effectively, but unfortunately, they do not have such infrastructure in their schools, and therefore, they cannot conduct a practical investigation or experiment for their respective learners. There are no way learners can learn and understand science if teachers skip practical investigations or experiments because they are part of the subject curriculum. Life sciences is a subject that involves scientific inquiry or investigation, which is aligned with the CAPS curriculum. The curriculum is a learner-centred approach wherein there is an interaction between the teachers and the learners (DBE, 2011). It obvious that some of the participants in this study are not skilled enough to perform practical experiments for the learners even if their schools have laboratories. In research conducted by Saeed Almuntasheri (2020), he finds that science teachers lacked sufficient skills to interact with their learners in science-based inquiry settings (Chapter 2, Section 2.10). From my experience, science teachers who cannot explain some basic science process skills to the learners find it difficult to perform practical investigations or experiments.

5.4.1.4 Theme 4: Language of the subject

Language plays an important role in all science classrooms. In South African secondary schools, the English language is mostly used as the language of teaching and learning, although some schools use Afrikaans as their medium of instruction. In rural areas where the learners' home language is not English, these are the learners that learn English as a second additional language. Netshivhumbe and Mudau (2021) state that both the language of instruction and the mother tongue language of learners is essential when teaching and learning science (Chapter 3, Sub-section 3.3.2). However, many of the participants during the pre-semi-structured interviews indicated that they encountered challenges when teaching life sciences because most of the learners are not fluent in English; therefore, as teachers, they find it difficult to deliver the subject lesson content in English because life science is rich in vocabulary and terminology and is known as the language of science. The vocabulary and terminology are concepts, terms and words contained in the life science content derived from other languages such as Greek and Latin. McComas (2013) suggested that science teachers should support learners whose language of teaching and learning is not the same as their mother tongue to understand the terminology and concepts of the subject.

Nevertheless, almost all the participants in this study reported difficulty in explaining the vocabulary and terminology in the subject contents to their learners in English, which is the language of the medium of instruction. These participants had to code-switch to the learners' mother tongue (Sepedi language) to explain the concepts to the learners even though, as teachers, they know that it is against the policy. Apart from the instructional language and mother tongue, the language of science is very critical when teaching and learning science, especially in rural areas. Another problem that may occur in code-switching is that the teachers may be unable to translate the terminology to the exact meaning in the learner's mother tongue, leading to misconceptions (Sikhombo, 2018). I believe that science teachers need to be supported with an appropriate teaching strategy that can be used in their respective classrooms when teaching their learners whose mother tongue differs from the language of teaching and learning.

5.4.1.5 Theme 5: Professional support

South African schools have experienced continuous curriculum reforms, and the teachers are expected to implement the curriculum changes whenever they are introduced. Teachers need support and training to execute the newly introduced curriculum; otherwise, the curriculum will be poorly delivered. Science teachers are not exempted from the challenges teachers face in delivering the curriculum content; many of them have complained of changes experienced in the curriculum. Adu and Ngibe (2014) reported that science teachers complained of many factors that hindered them from successfully delivering an effective curriculum (Chapter 2, Section 2.8). A. lack of content and pedagogical knowledge are some of the problems the science teachers experience whenever a new curriculum is introduced. Letshwene and du Plessis (2021) mentioned a lack of content knowledge as a major problem facing subject teachers (Chapter 2, Section 2.8). Ogunniyi and Mushayikwa (2015) and Alebous (2021) also concluded that a crucial problem South African teachers have is limited conceptual knowledge of the subject they teach (Chapter 2, Section 2.8).

All the participants in this study indicated that they needed support to effectively implement the subject curriculum, especially in subject content knowledge and teaching methods. However, they mentioned that they do not just want any kind of support that

does not meet their expectations; they must be consulted before any professional support is designed for them whereby they can offer their input (El-Deghaidy et al., 2014). The participants indicated that they are struggling with learners whose mother tongue is different from the medium of instruction. Hence, they need support on the type of teaching strategies which can assist them. I concur with Spaull (2013), who said that many of the science teachers in rural areas are struggling with pedagogical content knowledge and language of the subject (Chapter 2, Section 2.8). It was clear from the study that 65% of the participants who do not specialise in the subject find it difficult to deliver the content effectively. My experience taught me that teachers who do not specialise in the subject they teach deliver poor subject content of the subject except if they are supported, and thus, it will negatively affect the academic performance of the learners. On that note, I will support the clarion call of teachers asking for support to enable them to deliver an effective subject curriculum.

5.4.2 Interpretation of data of post-semi-structured interview themes

Unlike the pre-interview's themes, I extracted three themes from the analysis of data collected from the post-interviews. The discussion of these themes provided answers to the research questions raised in the chapter and the justification of choosing the theory in Chapter 3 for this study. Above all, the discussion of the themes is presented in the following section.

5.4.2.1 Theme 1: Science teachers

Life sciences is taught by science teachers, these the teachers that specialised in the subject and who have relevant qualifications to teach it but, unfortunately, many teachers that teach this subject in secondary school did not specialise in it. It was indicated by OECD (2009), that many teachers teaching science subject lack competency to teach the subject as a result of the following factors: non-specialisation, non-mastering of the concepts and non-fluency in the language of medium of instruction (Chapter 2, Section 2.8). In the same vein, based on the research conducted by Netshivhumbe and Mudau (2021), it was discovered that some South African science teachers who teach outside their specialty have below-basic content knowledge. Data from this study revealed that

most of the participants who teach outside their specialisation and even those that specialised in the subject they teach indicated request for support in one way or another. However, I agreed with Ogunniyi and Mushayikwa (2015), who say that teachers need motivation and support because of their many challenges. This support should be provided through professional teacher development (Chapter 2, Section 2.8).

After the CPD activities organised for the participants teaching Grade 10 in this study, each participant expressed their views towards the CPD interventional workshop. They were all overwhelmed and declared that the intervention assisted them, unlike other CPD workshops they attended. El-Deghaidy, et al. (2014) say teachers were worried about the type of PD workshop offered to them since many workshops did not meet their expectations (Chapter 2, Section 2.11). It was clear from the data gathered in this study that all the participants were happy about the nature of the intervention CPD programme. The participants further reported that they learnt much from one another during the interventional programme. Data from the study revealed that the interaction among the participants assisted them in exchanging and share ideas, knowledge and skills. At this junction, this revelation resonated with the theory which underpinned this study in the sense that Vygotsky's theory, otherwise known as the socio-constructivist theory of learning, deals with broadening and improving knowledge whenever individuals interact and collaborate in a setting (Taylor, 2018) (Chapter 3, Section 3.3). The participants in the study positively expressed their productivity when working collaboratively and interacting with one another during CPD activities in an organised workshop wherein they gained and shared ideas and knowledge. According to Vygotsky (1978), knowledge is built in a social context where learning occurs through interaction with others within their locality (El-Deghaidy et al., 2014) (Chapter 3, Section 3.3).

In addition, it was evident from the study that participants' perception towards CPD activities assisted and improved their pedagogical content knowledge, content knowledge, and teaching methods/strategies. A National Survey of Science and Mathematics Education report indicated that there are improvements in science teachers' outcomes for those that receive a momentous amount of CPD support (Banilower et al., 2018). It became very clear from the study and research finding that participants'

confidence and content knowledge in the subject improved significantly among those who do not specialise in teaching life sciences. This finding causes me to agree with Shah et al. (2015), who said that some teachers perceive CPD activities tremendously helpful in improving their professionalism and curriculum implementation (Chapter 2, Section 2.12).

5.4.2.2 Theme 2: Continuing Professional Development as an intervention to improve curriculum delivery

Curriculum delivery is influenced by curriculum changes in a particular country. Several factors can propel curriculum changes in any nation, such as economic, social, cultural, and political changes (Maharajh et al. 2016); other factors are pedagogical content knowledge, teaching methodology and learners' performance (Adu & Ngibe, 2014) (Chapter 2, Section 2.2). When curriculum changes occur in any country, the teachers are expected to deliver the new curriculum. As a science teacher, I found that when a new curriculum is introduced, teachers struggle extremely in the areas of pedagogical content knowledge, teaching methodology and teaching strategies. Consequently, these factors negatively affect the learners' performance and reduce the teachers' confidence in the classroom.

Many science teachers often complain about the delivery of their subject curriculum. Most of these teachers, especially those teaching in rural areas, mentioned some of the challenges that affect them in teaching effectively, which are not limited to only resources but also include pedagogical content knowledge and teaching methods (Spaull, 2013). On this note, I recommended an interventional programme for participants to assist them in leveraging their challenges and improving their curriculum delivery by boosting their confidence in the classroom. Research has proven that teachers experience progressive professional changes after undergoing a CPD interventional programme (Gore et al., 2017). Nevertheless, each participant in the study expressed their satisfaction with the CPD interventional programme they have undergone because it improved their professionalism and curriculum delivery. The participants were enthusiastic about the CPD programmes organised for them through the interventional workshop. Data from the study revealed that participants displayed confidence, used different teaching strategies and showed some improvement in their subject content knowledge during lesson

presentations. I agree with the South African Council for Educators which made CPD activities mandatory for all South African teachers because it will improve their teaching career (SACE, 2013).

Both the South African Department of Basic Education and Department of Higher Education and Training emphasised the importance of a CPD programme for teachers to improve their curriculum delivery. The two departments' Ministers launched an Integrated Strategic Planning Framework for Teacher Education and Development to strengthen the progress of CPD activities (DBE, 2015) (Chapter 2, Section 2.11). Researchers such as Saeed Almuntasheri (2020) reveals that CPD activity is an essential tool for teachers who experience challenges in their curriculum delivery due to curriculum changes (Chapter 2, Section 2.12). Above all, the study findings revealed that the CPD programme is an effective tool to assist science teachers struggling with delivering their subject curriculum.

5.4.2.3 Theme 3: CPD programme/activities design

Professional support for teachers is widely required to improve their curriculum delivery in classrooms. However, the question remains: What type of professional support is relevant for these teachers? There are different types of professional support or activities for teachers and not just formal training alone, for example, traditional activities (i.e., workshop), reformed activities (i.e., mentor) and peer professional development (i.e., peer teaching) (El-Deghaidy, 2014) (Chapter 2, Sub-section 2.10.1).

Science teachers have emphatically requested CPD programmes to assist them in their curriculum implementation, even though they do not just want a programme that does not positively impact their classroom practices or a programme where they do not have input before it is designed. It is not as if CPD programmes or activities are not planned and designed for teachers, but many such activities do not address their curriculum challenges. According to a research report by El-Deghaidy et al. (2014), teachers suggested that the most effective CPD programmes are self-initiated, including professional discussion, peer observation and informal networking. In these CPD programmes, teachers will work collaboratively in a group to provide solutions to their challenges by sharing skills, knowledge and ideas among themselves. It is very important

to note that it is not as if the teachers are ignorant about any formal knowledge regarding their profession, but they need to improve their previously acquired knowledge acquired to promote their professionalism, primarily because of constant changes in the curriculum.

Based on my experience, I noticed that one of the effective CPD interventional support strategies that can assist science teachers in their curriculum delivery challenges and thus have a positive impact on their classroom practices is a CPD programme designed through a workshop wherein teachers can work collaboratively in a particular environment to exchange ideas, knowledge and skills among themselves. Rose and Reynolds (2014) also reported that teachers had benefitted immensely from CPD programmes designed where teachers worked collaboratively and cooperatively with other teachers, resulting in an inquiry-based approach to pedagogy, the development of reflective and critical practice and problem-solving skills concerning teaching practices and development of dialogue (Chapter 2, Sub-section 2.10.1).

The study and data revealed that participants benefited from the nature of the CPD programmes designed wherein they worked among themselves and shared ideas, skills and knowledge. A CPD programme that follows a pedagogy-based and collaborative professional development (PD) approach in teaching will have a meaningful impact on the teaching quality of science teachers (Gore et al., 2017). Moreover, I concur with the theory of Vygotsky (Khan, 2019), otherwise known as the constructivist theory of learning, which was adopted as the study's theoretical framework. The theory deals with an individual who possesses unique constructed knowledge that is shared in social groups of people for more common knowledge through social interaction within a social setting (Knapp, 2018). It is, therefore, clear from this study that the participants learnt from one another; they shared knowledge and skills during the CPD programme interventional workshop. From my personal experience as a science teacher who has one time been appointed as a cluster leader wherein I facilitated a content workshop for my colleagues, I observed that teachers are very free and easy to discuss their curriculum challenges with colleagues. Moreover, the colleagues will discuss the challenges collectively and provide solutions. This model has assisted many schools or teachers working in isolation to improve their learners' academic performance. All participants in the study mentioned

that they wished that the CPD programmes could be conducted often for them since the programme assisted them in their classroom practices and improved their professionalism.

5.5 CHAPTER SUMMARY

The research has established that science teachers face many challenges in implementing their subject curriculum. They maintained that these problems resulted from constant changes in the country's education curriculum. They mentioned some of the problems, which include: lack of resources, poor training, complex curriculum design, poor content and pedagogical knowledge of teachers in the subject and lack of support. These challenges are very prevalent among science teachers teaching in rural areas because of the nature of their settings. Furthermore, it was revealed through data analysis that for science teachers to be productive and deliver the subject curriculum effectively; they need to be supported professionally. The teachers mentioned they were not receiving support, and even if the support was provided occasionally, it did not address their challenges or meet their expectations. However, any professional support that will be designed for the science teachers should be planned in such a way that it addresses the challenges facing them in implementing the curriculum.

5.6 CONCLUDING REMARKS

The study aimed to explore and establish the Grade 10 Life science teachers' perceptions of CPD programmes as an intervention to improve their curriculum delivery. The Grade 10 Life sciences teachers indicated they were not receiving the necessary support to implement the science curriculum in the face of many challenges. This problem did not only affect those science teachers that did not specialise in teaching the subject, but even those that specialised in the subject complained, especially in the rural areas. In addition, they mentioned that the small amount of support they receive is mostly once-off and does not address their challenges in the way it was planned and designed. It was therefore discovered that these teachers need professional support to implement the science curriculum and improve their classroom practices.

Therefore, an interventional CPD programme was designed for the participants (Grade 10 life sciences teachers) through an organised workshop wherein the teachers worked collaboratively while I served as a facilitator and mentor. The participants were glad and preferred to work collaboratively to solve their subject curriculum challenges because they could interact, share ideas, skill and knowledge among themselves. These views were held by both those that specialised and those that did not specialise in teaching the subject. They said the interventional CPD programme had improved their confidence and classroom practices. In addition, the participants said they preferred to be consulted before any CPD programmes are designed for them whereby they could outline their challenges in the curriculum, and such CPD programmes should not be once-off but should be conducted frequently.

Above all, in Chapter 5, I will present an overview of the initial research aim and objectives and a summary of the research findings by presenting academic and empirical findings. A discussion of the conclusion of this study will include the relevant responses to the main research question. Realistic and possible recommendations that can be implemented by schools, education districts, and provincial and national education departments will be offered, giving room for any future research to be developed or encouraged.

CHAPTER 6

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

6.1 INTRODUCTION

As I have indicated in Chapter 1, in Section 1.5 and Sub-section 1.5.1, the main research question of this study was chosen as: What is the Grade 10 Life science teachers' perceptions of CPD programmes as an intervention to improve their curriculum implementation? Chapters 2 and 3 provided the literature review on curriculum changes, curriculum implementation in science classrooms and how to improve the curriculum implementation of science teachers. Chapter 4 outlined the study's research design and methods, it presented the results, findings and discussion of the data collected through semi-structured interviews and classroom observation to explore and establish the Grade 10 Life science teachers' perceptions of CPD programmes as an intervention to improve their curriculum implementation and to propose a model. Following that, Chapter 5 presented the data analysis and interpretation of the research data.

This final chapter summarises the aim and objectives of this study, the methods used and the data analysis. Furthermore, a summary of the research findings and limitations of this study are presented as well as recommendations for further research. The following subsection provides a summary of the main research findings.

This last chapter of the study provides the summary, research conclusions and recommendations and proposes a model based on the study findings. Furthermore, this chapter suggests possibilities for further research, sets out the study's limitations and closes the study with concluding remarks. The following sub-section presents a summary of the main findings.

6.2 SUMMARY OF THE FINDINGS

This study comprises of six chapters which were demarcated as follows: Chapter 1 introduced and presented a detailed background to the study, the problem statement, the aim and objectives. Above all, it provided the overall scope of the research study. The study's main focus is on the perceptions of Grade 10 science teachers on CPD

programmes as an intervention to improve their curriculum implementation. Chapter 2 dealt with the contextual framework whereby I reviewed the literature of different scholars who have done similar studies. In Chapter 3, which focuses on theoretical and conceptual framework. I, identified the learning theory that underpinned the study, and I also elaborated on the similarity between the identified learning theory and the study together with its relevance. In addition, the conceptual framework was discussed. Therefore, this section summarises key scholarly review findings in Section 6.2.1 for Chapters 2 and 3. Chapter 4, explained the research methodology for the study. This study adopted a qualitative study of secondary schools in a particular circuit, and PRA was used as the research design and mode of inquiry. Chapter 5 presented the interpretation of data collected through semi-structured interviews and lesson observations. However, the summary of key empirical findings for Chapter 5 is discussed in Section 6.2.2. I sought to address both the primary research question and sub-questions as indicated in Chapter 1, Section 1.5.1 and Section 1.5.2, respectively.

6.2.1 Scholarly review findings

From Chapter 2, the contextual framework on curriculum changes and factors that contributed to curriculum changes were presented. In the study, it is evident that several countries worldwide experience curriculum changes propelled by various factors such as social, economic, political and cultural change (National Institute for Education Research, 1999; Maharajah et al., 2016). It was further discovered that learners' performance, pedagogical content knowledge, and teaching methodology, amongst other factors, can also contribute to curriculum changes (Adu & Ngibe, 2014). The curriculum changes in any country affect the curriculum implementers, which of course, are the teachers. For example, South Africa experienced curriculum changes after the new democratic government took power in 1994. In this study, the South African education system has been divided into two groups (Pre-apartheid and post-apartheid). The pre-apartheid education system was designed to favour a certain race while other races were disadvantaged. The post-apartheid education aimed to unify all the races under one designed new education curriculum that did not favour or disadvantage any race. Therefore, the education curriculum was changed immediately after the 1994 democratic

election of the government of the late Dr Nelson Mandela. However, the post-apartheid education system of South Africa continued to experience changes in the curriculum due to many factors, as indicated in Section 2.4.

I also found that the late Dr Nelson Mandela's administration had to change the education curriculum several times due to his government trying to address the inequalities in the country's teacher education system. The reason for the changes was that during pre-apartheid education, white teachers were more qualified and better resourced than teachers of other races; hence the government had to put some policies into place to mitigate the inequalities of education qualifications between the white teachers and teachers of other races (Ogunniyi & Mushayikwa, 2015).

In Section 2.8, I discovered that South African teachers, especially science teachers, are still faced with challenges in implementing the changes in the curriculum effectively despite the government's efforts to lessen the effects of some of these challenges, which include: poor training, complex curriculum design, vague language, time of implementation and lack of support (Adu & Ngibe, 2014). Letshwene and Du Plessis (2021) also mentioned that the lack of content knowledge of the subject by the teachers is also a big problem to them, especially among the teachers who are teaching outside their specialisation area (Netshivhumbe & Mudau, 2021). However, the problems the teachers face are worse in rural schools where they lack infrastructure such as laboratories, computers, libraries and running water (McCarthy & Oliphant, 2013).

In Section 2.10 and Sub-section 2.10.1, I found that the CPD programme for teachers was identified as an appropriate interventional tool to assist teachers in developing professionally and reduce the challenges experienced in delivering an effective curriculum. It was not as if the teachers were not supported professionally, but they complained that most of the support they received did not address their challenges in implementing the curriculum. It is in this vein that the teachers proposed that any CPD programme designed for them should be self-initiated, and they need to be involved and carried along. Rose and Reynolds (2014) recommended a CPD programme wherein teachers collaborate or cooperate with other teachers on common activities. According to

them, this is a successful CPD activity. Section 2.11 revealed that Gore et al. (2017) confirmed that a collaboratively designed CPD programme impacts teachers' teaching quality positively.

Chapter 3 presented the theoretical framework for this study. The constructivist theory of learning, founded on the research of theorists that include Piaget, Vygotsky, Feuerstein, Dewey and Bruner (Gravett, de Beer & du Plessis, 2018), was identified and chosen for this research. Lev Vygotsky's learning theory was chosen as the specific theory that is relevant and allied to this study. Sub-section 3.2.3 sets out Lev Vygotsky's social constructivism theory that deals with social interaction between learners or people in an environment. Vygotsky suggested that learning is a collaboration between teacher and learners; the teacher assumes a leadership role to support the learners. At this junction, this is one of the reasons why this theory is relevant to this study.

During the CPD programme intervention workshop organised for the science teachers, I took up the leadership role where I served as a facilitator and mentor to the science teachers whilst they worked collaboratively. This report also resonated with the suggestion made by Rose and Reynolds (2014) (See Section 2.10) and Gore et al. (2017) (See Section 2.12) that a CPD programme that is collaboratively designed is fruitful and thus has a positive impact on the teachers' professional career.

Social constructivism encourages the development of knowledge through the interactions each one has with one another (Taylor, 2018), and learning is built on existing knowledge and developed into new knowledge during the interaction with others within an environment (Schunk, 2012). From this premise, it follows that science teachers are not ignorant in knowledge on the subject they teach but need to improve their understanding and knowledge regarding the subject curriculum and their classroom practices. The interactions between the teachers and myself during the CPD programme interventional workshop whilst working collaboratively assisted them in exchanging ideas, skills and knowledge. By so doing, they acquired more new knowledge to improve their curriculum delivery.

6.2.2 Empirical research findings

The empirical data collected from the participants in this study were divided into two groups, namely, themes and categories of pre-semi-structured interviews and of post-semi-structured interviews (Table 5.2 & Table 5.3).

6.2.2.1 Empirical research findings for themes of pre-semi-structured interviews

Five major themes affect science teachers in the implementation of the curriculum, these include subject specialisation, teaching and learning support materials, school infrastructures, language of the subject and professional support (Chapter 5, Table 5.2).

The data revealed that not all the science teachers who teach a particular science subject have specialised in teaching the subject (Chapter 5, Sub-section 5.4.1.1). For example, some teachers who specialised in mathematics and physical sciences must teach life sciences based on their teaching qualifications. However, the teaching of a subject which is out of the specialisation field of the subject teacher may affect the implementation of the subject curriculum (Netshivhumbe & Mudau, 2021). It was discovered that most of the teachers relied on textbooks to teach the subject because they lacked appropriate subject content knowledge. This assertion was agreed by Du Plessis and Mestry (2019), who further said that such teachers may not be able to perform practical investigations with their learners. I found out that the teachers teaching out of their specialisation field are not only faced with the challenges of limited pedagogical content knowledge (PCK) but also spend more time explaining difficult concepts to the learners.

It was also evident from the study findings that teaching and learning support materials are important in aiding the curriculum implementation of science teachers in the classroom (Chapter 5, Sub-section 5.4.1.2). However, it was revealed that no other LTSM was used by the teachers than textbooks, chalk and blackboard. Lack of LTSM or resources thus adversely affects the teaching and learning of science. According to Adeniran (2020), where resources and facilities are readily available, teaching and learning science is highly effective. Non-availability of LTSM hampered the effectiveness of curriculum implementation of science subjects, and this could also hinder the interest

of learners in the subject. Consequently, it may lead to poor academic performance of the learners (Adeniran, 2020). Since there were limited resources available to the science teachers, they modified the curriculum to suit their context to the extent that they could not perform practical experiments with their learners because of a lack of science equipment and science kits (Du Plessis & Mestry, 2019).

I found through participants from the data extracted in this study that school infrastructure is among the factors that affect the implementation of the science curriculum (Chapter 5, Sub-section 5.4.1.3). Physical infrastructure such as classrooms, laboratories and libraries are important in enhancing effective science teaching and learning at schools (Netshivhumbe & Mudau, 2021). Unfortunately, many rural schools lack these facilities and therefore it affects the implementation of the curriculum (Maharajh et al., 2016). Teachers could not set up a practical class for the learners because there were no laboratories or equipment. Alebous (2021) indicated that science teachers would find it difficult to teach science in schools which are not well-resourced and that lack laboratories. Life sciences as a science subject require learners to be hands-on when they perform practical or investigations. The DBE (2011) outlined the practical investigations which teachers should perform with their learners in the subject pace setter, but if there are no laboratories, how can such practical sessions or investigations be performed? This, of course, will affect the curriculum implementation of the subject by the science teachers. With the lack of libraries, teachers and learners could not do research or find the meanings of some difficult science vocabulary. However, a lack of infrastructure will definitely affect the implementation of science education at schools.

Language plays an important role in the implementation of science curriculum. The findings of the study included the discovery that teachers struggle with the language of the subject, especially those who have not specialised in the subject (Chapter 5, Sub-section 5.4.1.4). Teachers often complain that they are unable to explain the difficult concepts and vocabulary to their learners most especially to the learners whose language of instruction is different from their mother tongue. Life science or science generally has its own language, which is entirely different from the language of teaching and learning and the mother tongue of the learners (McComas, 2013). It was revealed that learners in

rural areas struggled with English; as a result, the teachers tended to code-switch to explain the lesson content to these learners. The teachers themselves find it difficult to give exact meanings to some of the concepts and terminology which will not lead to misconceptions. Therefore, it is a very big challenge for rural science teachers to provide meanings for some science terminology and vocabulary. The teachers are required to know what type of teaching strategy can be used to assist them in explaining the scientific concepts to the learners since code-switching is not accepted and helpful.

The study showed that professional support for teachers is absolutely needed. The participants indicated that they require support to implement an effective curriculum due to its continuous changes (Chapter 5, Sub-section 5.4.1.5). It was discovered that participants complained that they were not supported in any way to implement the changes in the curriculum. Professional support is aimed at capacitating the teachers' knowledge and skills through organised CPD activities (Mafora & Phorabatho, 2013; Mohyuddin & Khalil, 2016; Vold, 2017). Although the DBE identified professional support for teachers as an important tool to assist them in improving their curriculum implementation, many of these programmes designed for teachers either do not address their challenges, or was just a once-off programme which is not continuous.

6.2.2.2 Empirical research findings for themes of post-semi-structured interviews

There are three main themes that contribute to the improvement of curriculum implementation and implementation in science classrooms. They include the following: science teachers, CPD as an intervention to improve curriculum implementation and CPD programme/activities design (Chapter 5, Table 5.3).

Teaching sciences require the subject teachers to be skilled and specialise in the subject. However, data extracted from the study indicated that not all the teachers who taught Grade 10 Life sciences specialised in teaching it (Chapter 5, Sub-section 5.4.2.1). Some of these teachers, however, have teaching qualifications but specialised in other fields of science, i.e. physical sciences and mathematics, agricultural science and mathematics. Many schools in rural areas compel their teachers to teach a subject they do not specialise in. It is assumed that a teacher specialising in physical sciences can teach or

should teach Life sciences, not considering that the contents and subject curriculum are far different. One will agree that teaching outside a teacher's specialisation field will result in insufficient subject content knowledge, especially to meet CAPS-related difficulties (Du Plessis & Mbunyuna,(2014). It was revealed from the study findings that the Grade 10 science teachers teaching Life science mentioned that the CPD interventional programme assisted them in improving their curriculum implementation and classroom practices. I attested to this fact because Ogunniyi and Mushayikwa (2015) cited that teachers need motivation and support to implement the curriculum effectively.

In addition, it was discovered that the professional development programme as an intervention improves the curriculum implementation of the science teachers (Chapter 5, Sub-section 5.4.2.2). The participants indicated that they are happy with the CPD intervention programme because it contributed positively to improving their curriculum delivery in the subject. Moreover, they said they acquired more knowledge and skills which assisted them professionally and boosted their confidence in the classroom. Researchers such as Saeed Almuntasheri (2020) also indicated that science teachers who lacked sufficient skills to relate with their learners in science classrooms improved after going through an organised CPD programme. Consequently, the CPD programme is very likely to improve the professional performance of teachers (Abdullah et al., 2018). As much as CPD programme is an essential tool to improve the science teacher's curriculum implementation, the question remains what type of CPD programme should be designed for teachers which will address their challenges in curriculum implementation and delivery. Moodley (2013) argues that workshops do not sufficiently prepare teachers for their classroom challenges, instead, they only make sure that teachers understand the policy. The study findings revealed that all the participants were satisfied and overwhelmed with the CPD programme designed for them through a workshop since it addressed their challenges.

In a null shell, it was discovered in the study that the CPD programme designed for the Grade 10 science teachers indeed assisted them in improving their curriculum implementation. Evidence from the data extracted from participants confirmed that they were all satisfied with the design of the CPD programme which was organised for them.

They indicated that collaborating in an organised CPD programme interventional workshop in a particular environment helped them exchange skills and knowledge. This statement made by these participants uphold the social constructivism theory, which is the theoretical framework that underpinned this study (Chapter 3, Sub-section 3.3). In a study by Nielsen (2015), it was revealed that teachers benefitted more from a sustainable CPD programme which was collaborative. De Jong et al. (2019) also shows that teachers who collaborate during a CPD programme improved their classroom practices. I noticed that both the teachers that specialised and those that did not specialise in teaching Life science all worked together collaboratively during the CPD interventional programme in the workshop to improve their pedagogical content knowledge and teaching strategies of the subject. The participants mentioned wanting the CPD programme to be continuous and not once-off. Khan (2021) says that teachers who undergo a continuous and collaborative CPD programme would increase their confidence and imbibe new ideas about the profession. It was discovered from the study findings that the participants (Grade 10 science teachers teaching Life sciences) improved in their curriculum implementation through the acquisition of further knowledge and skills obtained from the CPD programme.

6.3 RESEARCH CONCLUSIONS

The initial research question of the study was: What is the Grade 10 science teachers' perceptions of CPD programmes as an intervention to improve their curriculum implementing? (Chapter 1, Sub-section 1.5.1). The research conclusions are stated as answers to the initial research question, and the sub-questions were answered first because they serve as the building blocks for the main research question.

6.3.1 Sub-question 1: What are the challenges science teachers encounter in curriculum implementation?

In the first sub-question of the research, the study revealed that science teachers expressed the challenges they faced in implementing the curriculum. Continuous changes in the curriculum have led to instability and difficulty for the teachers to implement. While adjusting to changes to the curriculum, another one was introduced to

replace the previous one. Teachers often complained of a lack of resources to implement or deliver the curriculum effectively. Science teachers in rural areas mentioned that laboratories, libraries and adequate classrooms are unavailable. Science requires teachers to perform practical or investigations with their learners; however, the non-availability of science kits and equipment made it very difficult accomplish. Moreover, the non-availability of LTSM is characterised as one of the major problems for science teachers. Most rural schoolteachers only use textbooks, chalk and a blackboard; there are no other forms of teaching aids that can assist the teachers and support the learners in science classrooms, such as projectors, computers or photocopy machines. It was discovered that many rural schools lacked the financial resources to procure the materials mentioned above. Science teachers emphatically complained about the lack of support by the school management and education department. It was revealed in the study findings that teachers were left alone and struggled to implement the curriculum.

Some teachers who did not specialise in teaching a specific subject but were compelled by the school management to teach it, complained of limited pedagogical content knowledge and subject matter knowledge. To implement and deliver any curriculum effectively, teachers, who are otherwise referred to as curriculum implementers, require support and training; unfortunately, this does not happen. The teachers mentioned that even though the department organises a CPD workshop for them through education districts, the programme does not address their challenges, and often such CPD programmes are just once-off; there is no continuity. Science teachers emphasised the absence of continuous and sustainable CPD support as one of the challenges they face. The teachers said they wanted to improve their curriculum implementation, but due to the absence of support and training to implement any newly introduced curriculum which comes with a new design, they had to do things the old way, which hampered their productivity. Nonetheless, support for science teachers is critical to improving their curriculum implementation.

6.3.2 Sub-question 2: What are the needs of CPD programmes by science teachers?

On the second sub-question of the research, science teachers are the implementers of the science curriculum; hence they need to be supported to deliver and implement the curriculum meritoriously. Science teachers have mentioned that they require support, mentorship and training, but more importantly, they indicated that CPD programmes will be the effective support they require. The teachers mentioned that the CPD programmes organised by the education district subject advisers do not meet their needs; therefore, they want a CPD programme to address the problems they face when implementing and delivering the curriculum. The teachers suggested that they ought to be consulted before any CPD programme is designed for them wherein they will have an opportunity to advise the type of activities that is relevant and which will meet their expectations, and not just a CPD programme that is designed and forced on them. Furthermore, the teachers stated they wanted a CPD programme that is continuous and sustainable. They cited that many CPD programmes designed for them are once-off and are not continuous. On this premise, they suggested that the CPD programme should not just be a once-off but must be continuous to impact them positively. In addition, the science teachers indicated that they preferred a CPD programme wherein they can work collaboratively in a particular setting; by so doing, they can exchange ideas and acquire more knowledge and skills from one another.

6.3.3 Sub-question 3: How does a proposed CPD programme assist science teachers in their curriculum implementation?

On the third sub-question of the research, the study confirmed that the CPD programme designed for the science teachers took into cognisance their needs to improve the curriculum implementation. It is imperative to understand the challenges these teachers face in implementing and delivering the curriculum before any CPD programme is designed and presented to them. Therefore, the CPD programme was designed to address the problems or challenges the science teachers indicated. Furthermore, during the CPD interventional workshop, the science teachers interacted and worked collaboratively. Working collaboratively enhances productivity and improves knowledge.

The teachers were able to work together and develop a common lesson plan, thereby, they know what to teach and how to teach. Therefore, the teachers developed confidence in their respective classrooms even where science materials were unavailable to demonstrate practical or investigations for their learners. They showed some skills to improvise and demonstrate such science investigations with their learners. In addition, it was revealed that the teachers who were used to code-switching had acquired and learnt a teaching strategy to assist the learners in understanding the difficult scientific concepts and vocabulary without creating any misconceptions. More so, the science teachers showed tremendous improvement in the subject content knowledge and teaching methods, this improvement is highly noticeable among the science teachers that do not specialise in teaching Life science.

6.3.4 Main research question: What is the Grade 10 science teachers' perceptions of CPD programmes as an intervention to improve their curriculum implementation?

On this main research question, the study determined the Grade 10 science teachers' perceptions of CPD programmes as an intervention to improve curriculum implementation. On this note, the perceptions of the science teachers were classified into two categories, namely, perceptions of the science teachers regarding their previous CPD programmes and regarding the recent CPD programmes.

(i) Category one: Perceptions of the science teachers regarding their previous CPD programmes.

The study findings revealed that the science teachers were not pleased or satisfied with the previous CPD programmes designed and presented to them. These programmes were conducted by the subject advisers from the education district. However, the teachers complained they were not involved or consulted before such programmes were designed and planned. Therefore, they did not address the problems or challenges they faced in implementing and delivering the curriculum. The teachers preferred CPD programmes wherein they could advise on the type of CPD activities that would assist them in improving their professionalism and classroom practices. As this has never happened,

the teachers lost interest in attending any CPD programmes organised and initiated by the education district subject advisers. They viewed it as a waste of time because the CPD programmes were not helping them or addressing their curriculum challenges.

In addition, the science teachers complained that most of the CPD programmes presented to them are once-off, and there is no continuity. This is another frustration they were faced with. The teachers said that they want a CPD programme which is continuous and sustainable; hence it will improve their knowledge. They will acquire more skills which will promote their curriculum implementation. The teachers summarily believed they were not receiving any support to improve their curriculum delivery because the planned and designed CPD programmes did not address their challenges, they were not consulted before such programmes were planned and they were just once off programme with no continuity.

(ii) Category two: Perceptions of the science teachers regarding their recent CPD programmes.

The science teachers expressed their views after participating in the CPD interventional programme I designed and organised for them in the form of a workshop. The study confirmed that the teachers were happy and satisfied with the programme. The CPD programme was planned and designed based on my consultations with the teachers wherein they indicated the challenges limiting their curriculum implementation. The study findings revealed that the CPD interventional programme was helpful and benefited the teachers. The teachers indicated that the programme fully addressed their curriculum challenges. Furthermore, they mentioned gaining more knowledge and skills through the intervention. I noticed that almost all the participants' confidence in their respective classrooms increased. The teachers said their pedagogical content knowledge (PCK), content knowledge, teaching methods and teaching strategy improved. Moreover, the science teachers stated that they enjoyed the CPD interventional programme because it was designed in such a way that it enabled them to interact with one another and work together collaboratively. This factor allowed them to share ideas, skills and knowledge among themselves. Therefore, they acquired more knowledge and skills from one another

through the CPD programme. Finally, the teachers expressed their views by indicating that CPD intervention programmes such as the one I organised for them should be continuous because they would improve their curriculum implementation.

6.4 CONTINUING PROFESSIONAL DEVELOPMENT PROGRAMME INTERVENTION MODEL

The summary of the answers to the main research question and sub-questions based on the study findings impelled me to develop a model that can be used to design an effective and productive CPD programme to improve science teachers' curriculum implementation.

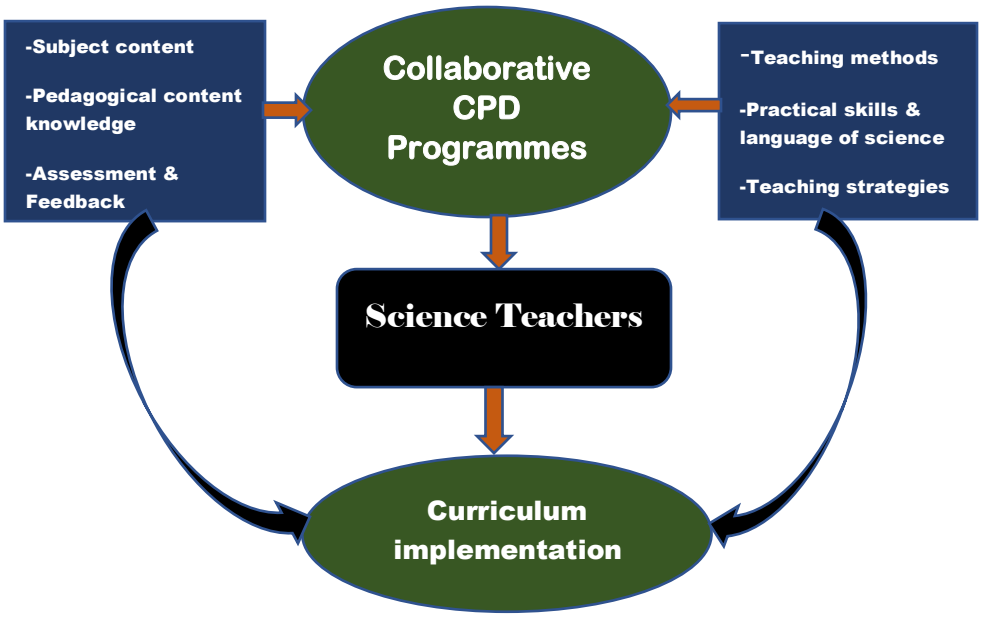

Figure 6.1: Proposed model for an effective CPD programme intervention for science teachers

(INPUT-BASED SOLUTION-IBS)

Figure 6.1 shows the proposed model for an effective CPD programme intervention for science teachers. I developed this proposed model based on the result and success of

the CPD programme as an intervention for science teachers to improve their curriculum implementation (Chapter 4, sub-section 4.4.3 & Chapter 5).

Findings from the study revealed that Grade 10 science teachers teaching Life sciences in Ngwaritsi circuit, Sekhukhune South district, Limpopo provinces faced many challenges to deliver the science curriculum effectively. One of the problems is due to constant changes in the country's education curriculum, which led to poor delivery of the curriculum. During the pre-semi-structured interviews with the participants (Grade 10 science teachers teaching Life sciences), it was also revealed that some participants could not implement the curriculum effectively because they did not specialise in the subject they teach but were compelled to teach it. This factor resulted in poor content knowledge of the teachers and limited pedagogical content knowledge (PCK). Even the teachers that specialised in the subject were also faced with challenges to implementing the curriculum effectively; for example, lack of resources, limited content knowledge and support were some challenges they experienced. The findings in the study revealed that the support provided by the district subject advisers did not address their needs, more so, they are once-off programmes and not continuous.

In that premise, I organised a two-day workshop for the participants (Grade 10 science teachers teaching Life science) to assist the teachers in lessening their curriculum challenges and improving their curriculum implementation. I presented a CPD programme I designed for them in the two-day workshop. However, I considered the curriculum challenges the participants mentioned as factors hindering them from implementing the curriculum effectively. The CPD programme was designed in reference to social constructivism theory, the theoretical framework that this study adopted. During the workshop, I presented a topic from the Grade 10 Life science syllabus, and all the participants were requested to contribute and explain how they would teach such topics with their learners in the classroom. The participants were requested to develop a lesson plan wherein they collaborated and exchanged ideas, knowledge and skills. At this point, I served as a facilitator and mentor to the participants. All the participants, those that specialised and the ones that did not specialise in the subject, worked together by sharing their experiences. I provided the participants with answers to their questions where they

needed more clarity and information regarding the subject curriculum, such as the teaching strategy, teaching method, pedagogical content knowledge (PCK) and assessment. At the end of the workshop, the participants developed a lesson plan (see Chapter 4, Sub-section 4.3.3). The science teachers reported during the post-semi-structured interviews that they acquired more knowledge during the CPD programme interventional workshop because it was designed and planned so that it addresses their curriculum challenges. They further indicated that working together with other colleagues enhanced their productivity.

The proposed model comprises the following features: a collaborative CPD programme, CPD components, and science teachers.

a. Collaborative CPD programme

The study's findings strongly agreed with the social constructivism theory, which affirms that knowledge is improved through social interaction between social groups of people with much knowledge in common within an environment (see Chapter 3, Sub-section 3.2.3). Lev Vygotsky, founder of social constructivism, said that learning is a collaboration between the teacher and learners with the teacher taking a leadership role (Behera, 2014). This is the main reason why the CPD programme was designed so that all science teachers with common knowledge came together and worked collaboratively during the CPD programme. One of the benefits of collaboration among teachers during the CPD programme is that it improves their knowledge and boosts their confidence in the classroom whether the teacher specialises in the subject taught or not. It will also strengthen the knowledge of the newly recruited teachers because they will work with experienced teachers. In turn, the experienced teachers can also benefit from the newly recruited teachers regarding new innovations.

b. CPD components

For a CPD programme to be effective, it must be designed to address the needs and challenges of the teachers. Therefore, to assist these teachers, the CPD programme must be designed to incorporate the following curricula components: subject content, pedagogical content knowledge, teaching strategies, teaching method, practical skills and

language of science, assessment and feedback. Teachers will find it very difficult to deliver the curriculum if they lack or have limited knowledge in the following: subject matter knowledge, pedagogical content knowledge, process skills or practical skills and teaching strategy (Alebous, 2021; Letshwene & Du Plessis, 2021; Spaull, 2013).

I discovered from the empirical findings of this study that teachers improved their curriculum delivery after they attended the CPD programme interventional workshop (see Chapter 5, sub-section 5.3.2.2). According to Rose and Reynolds (2014), teachers will gain positively from a CPD programme which includes curricula components in its design, and it will result in teachers developing reflective and critical practice, an enquiry-based approach to pedagogy, development of problem-solving skills and job satisfaction. The participants' responses during post-semi-structured interviews indicated they were satisfied with the CPD programme design because it addressed their needs and curriculum challenges.

c. Science teachers

According to this study, science teachers were those teachers who had qualifications in any of the science fields but were not necessarily teaching the subject of their specialisation. The study findings revealed that not all the Grade 10 science teachers teaching Life sciences specialised in the subject. In addition, it was further revealed that the teaching experiences of these teachers varied (see Chapter 5, Table 5.1). The teachers mentioned the challenges they were experiencing in implementing the curriculum effectively (see Chapter 5, Sub-section 5.3.2.1). All the science teachers (participants) indicated a need for professional support which would meet their curriculum challenges and thus improve their curriculum implementation. I, therefore, designed and presented a CPD programme to the participants in a workshop as an intervention aimed at addressing their challenges and improving their curriculum implementation. The participants were pleased with the CPD programme because it addressed their curriculum problems.

However, the study's findings found that the participants (Grade 10 science teachers teaching Life sciences) want the CPD programmes to be continuous, which should be conducted often.

In summary, I designed the proposed CPD programme intervention model, which I named "Input-Based Solution". The word 'Input' referred to all the curricula components: subject content, pedagogical content knowledge (PCK), assessment and feedback, content knowledge, practical skills, the language of science and teaching strategies. All of them go into the collaborative CPD programme. These components address the challenges identified by the science teachers to improve their curriculum implementation. Therefore, it is important that when a CPD programme is designed and planned for the teachers, it must include all the components. It should be noted that the challenges identified by the teachers will inform the components.

In addition, the CPD programme should be designed collaboratively wherein the teachers work together with other colleagues and the programme organiser, i.e., the subject adviser, who will serve as a facilitator and mentor. Thus, this programme will be presented in the form of a workshop. Above all, the knowledge and the skills the science teachers acquire during the CPD programme will improve their curriculum implementation.

I strongly believe that if teachers receive professional support and assistance in their professional careers, they will improve their classroom practices and not deliver poor or limited content knowledge of the subject matter. The learners are the final recipients of the product of a skilled and well-knowledgeable teacher who has received continuous and effective professional development programmes. This teacher will implement the subject content efficaciously, which will positively impact the learners' academic performance.

6.5 RECOMMENDATIONS

In the following paragraphs, I provide recommendations concerning Grade 10 science teachers' perceptions of CPD programmes as an intervention to improve their curriculum implementation. It should be noted that improving science teachers' curriculum implementation is paramount, even though it cannot happen suddenly. It requires the

continuous intervention of CPD programmes to address challenges faced by the teachers. There is no once-off remedy that will bring about instant improvement in the curriculum delivery of science teachers.

After carefully analysing the data and drawing conclusions from the main findings in the previous chapter, I submit the following recommendations for various education stakeholders.

6.5.1 Governance level (DBE)

The recommendations and suggestions emanating from the study's findings are considered as possible solutions to the problem being investigated. This section makes governance recommendations to improve science teachers' curriculum implementation through the CPD programme as an intervention.

The following four recommendations are directed to the Department of Basic Education (DBE).

Recommendation 1

The DBE should ensure that science teachers are supported professionally primarily due to continuous changes in the country's education curriculum, which create challenges that hamper their classroom practices.

Recommendation 2

Policies should be made whereby all teachers are involved in practical training. Since all the colleges of education in the country have been closed down, many current teachers have acquired theoretical knowledge from universities; they are not exposed to enough professional practical training.

Recommendation 3

The DBE should adopt a policy that will make it mandatory for science teachers to receive a CPD programme at least once a month. The effectiveness and its implementation should be strictly monitored for accountability.

Recommendation 4

The DBE should consider and adopt the CPD programme intervention model (Input-Based Solution) as a tool to design CPD programmes for the science teachers in the country since the study findings revealed that the intervention improved the teachers' curriculum delivery.

Recommendation 5

There should be enough financial allocations from the national budget to support CPD programmes. In as much it is a continuous programme, it will require ongoing financial support.

Recommendation 6

The DBE should make it a point of duty that all secondary schools across the nation have proper physical infrastructures such as laboratories, libraries and enough classrooms to aid effective science teaching and learning.

Recommendation 7

The DBE must ensure that all secondary schools are provided with science learning and teaching support materials such as science kits and equipment, projectors, computers and photocopying machines.

6.5.2 Provincial Department of Education

Recommendation 8

The province must ensure that CPD programmes for science teachers are effectively planned and executed in each district to improve their curriculum implementation and delivery.

Recommendation 9

The province should adopt the proposed CPD programme intervention model (Input-

Based Solution) as a guide to develop any CPD programmes for the science teachers to leverage the curriculum challenges they are facing, thereby improving their classroom practices.

Recommendation 10

The province should monitor the distribution of science resources across the province by making sure that all the schools within the districts receive their allocated materials because science teachers complained of a lack of resources to perform science practical or investigations.

Recommendation 11

The province should ensure that the CPD programmes are adequately financed and monitor the usage of the allocated funds. Furthermore, it should be responsible for ensuring accountability on the disbursement and usage of the finances for the same programmes.

Recommendation 12

In addition, the province can outsource experts to train and empower the curriculum support officials (subject advisors) responsible for teacher professional support. This approach will ensure the quality and effectiveness of the CPD programmes since the science teachers decry non-effective CPD programmes.

6.5.3 Education Districts

Recommendation 13

The district subject advisors should adopt and use the proposed CPD programme intervention model (input base solution) when planning the CPD programmes for science teachers. This model requires the subject advisors to consult the teachers to obtain their needs and understand their challenges before it is being designed and presented to them.

Recommendation 14

The CPD programme should be designed as a workshop whereby science teachers work collaboratively in a specific setting. This approach has been proven in the study findings as improving the curriculum implementation of the teachers tremendously since they acquired more knowledge and skills through the intervention.

Recommendation 15

The subject adviser at the districts should formulate subject committees. These committees will enable and create a platform for science teachers to interact, cooperate and exchange ideas coupled with experiences that will promote their profession.

Recommendation 16

The district subject advisors must make frequent school visits to support science teachers, enabling them to understand the challenges they face in their respective classrooms. They should also monitor the implementation of the science curriculum by teachers in schools.

Recommendation 17

Education districts should advise and monitor school management teams (SMT) to procure science materials/ resources when and where needed. This procurement will aid teaching and learning, thus improving teachers' curriculum implementation.

6.5.4 Institutional level (School)

Recommendation 18

The school SMT should ensure that the science teachers attend CPD programmes organised for them to improve their knowledge of the subject they are teaching.

Recommendation 19

The school SMT should encourage science teachers to belong and participate in professional bodies. They will acquire new innovations and knowledge to improve their classroom practice by participating in the professional bodies.

Recommendation 20

The school science Head of Department (HOD) should monitor and support the science teachers thereby; they will know the kind of support the teachers require and advise the school principal and subject adviser accordingly.

Recommendation 21

The science HOD should ensure and prioritise the science equipment procurement for the science department. This procurement will assist science teaching and learning, especially during practical experiments/investigations.

Recommendation 22

The school SMT should allocate a budget to cater for a competent education service provider who can implement the proposed CPD programme intervention model (Input-Based Solution) and conduct a CPD programme for science teachers wherein they will gain knowledge and skills about the subject matter.

6.6 AVENUES FOR FURTHER STUDIES

The main aim of the study is to explore and establish the perceptions of Grade 10 science teachers on CPD programmes as an intervention to improve the curriculum implementation, however it will be of interest to find out if the CPD programmes of science teacher can have a direct influence on learners' academic performance. I am of the view that there should a parameter to measure the success of science teachers CPD programmes on the learners' academic performance. An improved academic performance of learners boosts the morale of the teachers and education stakeholders as a whole.

Furthermore, since the study findings revealed that science teachers preferred a CPD programme that is collaborative because it improved their curriculum implementation through acquisition of further skills and knowledge, it will be a good thing to research on other possible factors that assist and support science teachers to improve the implementation and delivery of curriculum. Curriculum implementation is very important to all education stakeholders, but teachers are the main curriculum implementers

therefore they require sufficient knowledge and skills to deliver an effective curriculum hence they need support continuously.

6.7 LIMITATIONS OF THE STUDY

It is critical to understand the study's limitations to put the findings in context. The biggest limitation was that the study only concentrated on Grade 10 science teachers to explore and establish their perceptions of the CPD programme as an intervention to improve curriculum delivery in twelve secondary schools of Ngwaritsi circuit, Sekhukhune South, Limpopo province.

The generalisability of the results is limited since the research focused on Grade 10 science teachers only while other grades' science teachers were not involved. In addition, the research was conducted in twelve secondary schools of only one circuit in Sekhukhune South district, likewise, other circuits in the districts were not involved.

Nonetheless, the research results were firmly grounded under inquiry since semi-structured interviews and lesson observations were employed to gather information from the research participants. This means that even though the results of this study cannot be generalised, they can be used effectively in similar circumstances.

6.8 CONCLUDING REMARKS

The ultimate goal of the study was to explore and establish the perceptions of Grade 10 science teachers on the CPD programme as an intervention to improve curriculum delivery. The study has established that the CPD programme contributed significantly to the improvement of curriculum implementation of science teachers. Nonetheless, before planning and designing the programme, it is imperative to consult and understand the curriculum challenges of the science teachers.

From my professional experience as a former science teacher and cluster leader, I have noticed science teachers struggling to implement an effective curriculum in their respective classrooms, especially among those teaching in rural areas, which has caused the teachers to be frustrated and lose confidence. On this basis, I am passionately interested in improving science teachers' curriculum implementation. In this quest, CPD

programmes have proven to be an important tool that can improve the curriculum implementation based on the study findings.

The advantages of this study are that it will broaden all education stakeholders' understanding regarding the challenges science teachers face to implement and deliver the curriculum effectively. They will also see the importance of CPD programmes as an intervention to improve the teachers' curriculum implementation.

In conclusion, I am greatly motivated as I will be the voice of the science teachers by submitting my research recommendations to the research directorate of the DBE for implementation; hopefully, the concerns of the science teachers will be addressed.

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APPENDICES

7.1 Appendix A – Ethical Clearance

UNISA university of south africa

UNISA COLLEGE OF EDUCATION ETHICS REVIEW COMMITTEE

Date: 2021/02/10

Ref: **2021/02/10/49254103/13/AM**
Name: Mr AA OBILANA
Student No.: 49254103

Dear Mr AA OBILANA

Decision: Ethics Approval from 2021/02/10 to 2026/02/10

Researcher(s): Name: Mr AA OBILANA
E-mail address: 49254103@mylife.unisa.ac.za
Telephone: 076 065 5530

Supervisor(s): Name: Dr H. O Mokiwa
E-mail address: mokiwho@unisa.ac.za
Telephone: 012 429 6562

Title of research:

SCIENCE TEACHERS' PERCEPTIONS ON CONTINUING PROFESSIONAL DEVELOPMENT: CASE STUDY

Qualification: PhD CURRICULUM AND INSTRUSTIONAL STUDIES

Thank you for the application for research ethics clearance by the UNISA College of Education Ethics Review Committee for the above mentioned research. Ethics approval is granted for the period 2021/02/10 to 2026/02/10.

*The **medium risk** application was reviewed by the Ethics Review Committee on 2021/02/10 in compliance with the UNISA Policy on Research Ethics and the Standard Operating Procedure on Research Ethics Risk Assessment.*

The proposed research may now commence with the provisions that:

1. The researcher will ensure that the research project adheres to the relevant guidelines set out in the Unisa Covid-19 position statement on research ethics attached.
2. The researcher(s) will ensure that the research project adheres to the values and principles expressed in the UNISA Policy on Research Ethics.

3. Any adverse circumstance arising in the undertaking of the research project that is relevant to the ethicality of the study should be communicated in writing to the UNISA College of Education Ethics Review Committee.
4. The researcher(s) will conduct the study according to the methods and procedures set out in the approved application.
5. Any changes that can affect the study-related risks for the research participants, particularly in terms of assurances made with regards to the protection of participants' privacy and the confidentiality of the data, should be reported to the Committee in writing.
6. The researcher will ensure that the research project adheres to any applicable national legislation, professional codes of conduct, institutional guidelines and scientific standards relevant to the specific field of study. Adherence to the following South African legislation is important, if applicable: Protection of Personal Information Act, no 4 of 2013; Children's act no 38 of 2005 and the National Health Act, no 61 of 2003.
7. Only de-identified research data may be used for secondary research purposes in future on condition that the research objectives are similar to those of the original research. Secondary use of identifiable human research data requires additional ethics clearance.
8. No field work activities may continue after the expiry date **2026/02/10**. Submission of a completed research ethics progress report will constitute an application for renewal of Ethics Research Committee approval.

Note:

The reference number **2021/02/10/49254103/13/AM** *should be clearly indicated on all forms of communication with the intended research participants, as well as with the Committee.*

Kind regards,

Prof AT Motlhabane
CHAIRPERSON: CEDU RERC
motlhat@unisa.ac.za

Prof PM Sebate
EXECUTIVE DEAN
Sebatpm@unisa.ac.za

7.2 Appendix B: Request to conduct research in Limpopo DBE

UNISA college of education

UNIVERSITY OF SOUTH AFRICA

SCHOOL OF POST GRADUATE STUDIES

COLLEGE OF EDUCATION

PRETORIA.

5TH MAY 2020

THE HEAD OD DEPARTMENT

Limpopo Department of Education

Dear Sir

REQUEST FOR PERMISSION TO CONDUCT RESEARCH

I am Aderemi Adesoji Obilana, a Ph.D (Ph.D in Curriculum Studies) student of University of South Africa.. My supervisor is Dr H.O Mokiwa.

I am currently conducting a research study titled, "SCIENCE TEACHERS PERCEPTIONS IN CONTINUING PROFESSIONAL DEVELOPMENT PROGRAMME: CASE STUDY".

I am kindly requesting permission to use twelve of your schools in your province in Sekhukhune South district, Ngwaritsi circuit.

The aim of the research study is to establish science teachers' perceptions on continuing professional development programmes using Participatory Action Research as a methodology.

The province will benefit in the research study in the sense that the result of the research will be shared with the province. And it will enhance their curriculum strategies and management.

There are no foreseeable risks associated with the research study and your approval will not be used to lever participants' and school' decisions to participate in the study at any stage during the investigation nor the name of the school, or the names of the participants will appear or referred to in my dissertation or other outputs.

The nature of the intervention is explained in the research proposal. The consent of teachers and parents, and the assent of learners will be requested prior to the intervention.

I hereby attached my research proposal to the request letter. Social distancing and health protocol will be observed because of covid-19

For further information, correspondence or query about the research study, kindly contact me or my supervisor on the details: Mr A.A Obilana (076065530) OR Dr H.O Mokiwa (0124296562)

Thank you for the cooperation.

Yours sincerely

Aderemi Obilana

Dr H.O. Mokiwa

7.3 Appendix C – Permission granted to conduct research by Limpopo DBE

LIMPOPO
PROVINCIAL GOVERNMENT
REPUBLIC OF SOUTH AFRICA

DEPARTMENT OF
EDUCATION

CONFIDENTIAL

Ref: 2/2/2 Enq: Mabogo MG Tel No: 015 290 9365 E-mail:MabogoMG@edu.limpopo.gov.za

Obilana AA
54 Ngwanamatlang
Jane Fuse
1085

RE: REQUEST FOR PERMISSION TO CONDUCT RESEARCH

1. The above bears reference.

2. The Department wishes to inform you that your request to conduct research has been approved. Topic of the research proposal: **"SCIENCE TEACHERS PERCEPTION ON CONTINUING PROFESSIONAL DEVELOPMENT :CASE STUDY "**

3. The following conditions should be considered:

3.1 The research should not have any financial implications for Limpopo Department of Education.

3.2 Arrangements should be made with the Circuit Office and the School concerned.

3.3 The conduct of research should not in anyhow disrupt the academic programs at the schools.

3.4 The research should not be conducted during the time of Examinations especially the fourth term.

3.5 During the study, applicable research ethics should be adhered to; in particular the principle of voluntary participation (the people involved should be respected).

REQUEST FOR PERMISSION TO CONDUCT RESEARCH: OBILANA AA

Cnr. 113 Biccard & 24 Excelsior Street, POLOKWANE, 0700, Private Bag X9489, POLOKWANE, 0700

3.6 Upon completion of research study, the researcher shall share the final product of the research with the Department.

4 Furthermore, you are expected to produce this letter at Schools/ Offices where you intend conducting your research as an evidence that you are permitted to conduct the research.

5 The department appreciates the contribution that you wish to make and wishes you success in your investigation.

Best wishes.

25/06/2020

Mrs Dederen KO
Acting Head of Department

Date

REQUEST FOR PERMISSION TO CONDUCT RESEARCH: OBILANA AA

7.4 Appendix D – Request to conduct research in Ngwaritsi circuit

UNIVERSITY OF SOUTH AFRICA

SCHOOL OF POST GRADUATE STUDIES

COLLEGE OF EDUCATION

PRETORIA.

5TH MAY 2020

THE CIRCUIT MANAGER

Ngwaritsi Circuit, Limpopo Department of Education

Dear Sir

REQUEST FOR PERMISSION TO CONDUCT RESEARCH

I am Aderemi Adesoji Obilana, a Ph.D (Ph.D in Curriculum Studies) student of University of South Africa.. My supervisor is Dr H.O Mokiwa.

I am currently conducting a research study titled, "SCIENCE TEACHERS PERCEPTIONS IN CONTINUING PROFESSIONAL DEVELOPMENT PROGRAMME: CASE STUDY".

I am kindly requesting permission to use twelve of your schools in your circuit, Secondary Schools respectively.

The aim of the research study is to establish science teachers' perceptions on continuing professional development programmes using Participatory Action Research as a methodology.

The circuit will benefit in the research study in the sense that the result of the research will be shared with the province.

There are no foreseeable risks associated with the research study and your approval will not be used to lever participants' and school' decisions to participate in the study at any stage during the investigation nor the name of the school, or the names of the participants will appear or referred to in my dissertation or other outputs.

The nature of the intervention is explained in the research proposal. The consent of teachers and parents, and the assent of learners will be requested prior to the intervention.

I hereby attached my research proposal to the request letter. Social distancing and health protocol will be observed because of covid-19.

For further information, correspondence or query about the research study, kindly contact me or my supervisor on the details: Mr A.A Obilana (076065530) OR Dr H.O Mokiwa (0124296562). Thank you for the cooperation.

Yours sincerely

Aderemi Obilana

Dr H O Mokiwa

7.5 Appendix E – Permission granted to conduct research in Ngwaritsi circuit

LIMPOPO
PROVINCIAL GOVERNMENT
REPUBLIC OF SOUTH AFRICA

DEPARTMENT OF
EDUCATION

SEKHUKHUNE SOUTH DISTRICT
NGWARITSI CIRCUIT

Enq : Marodi M
Tel : 0822582479

30 June 2020

Mr A A Obilana

Re : Request to conduct research

The above matter bears reference.

The above-named circuit wishes to inform you that your request to conduct research at Kgotswane, Kgoshi Moroangoato Tisane and Tenyane Secondary Schools is hereby granted.

The Circuit reminds you that you should adhere to the conditions as set out in the approval granted to you by the Limpopo Education Department.

The Circuit wishes you success in your endeavour.

Yours faithfully

Marodi Makopane
(Circuit Manager)

DEPARTMENT OF EDUCATION
NGWARITSI CIRCUIT OFFICE
THE CIRCUIT MANAGER
30 JUN 2020
PRIVATE BAG X122
NEBO, 1059
LIMPOPO PROVINCE

7.6 Appendix F – Letter of consent to Grade 10 science teachers

UNISA college of education STUDIES

UNIVERSITY OF SOUTH AFRICA

SCHOOL OF POST GRADUATE

COLLEGE OF EDUCATION

PRETORIA.

5TH AUGUST 2020

Grade 10 Science teachers

Dear Sir/Madam

REQUEST FOR PERMISSION TO CONDUCT RESEARCH

I am Aderemi Adesoji Obilana, a Ph.D degree (Ph.D in Curriculum Studies) student of University of South Africa. My supervisor is Dr H.O. Mokiwa.

I am currently conducting a research study titled, "Science teachers' perceptions in continuing professional development programme: Case Study".

I have chosen your school to collect my data.

I will love to request your participation. As a Life Science teacher, you will be interviewed and also requested to teach before and after the intervention. During the lesson presentations, the researcher will observe your lesson presentation. All other procedures shall be communicated to you.

I, therefore request your participation in my research study which will take place in your school. I will ensure privacy, anonymity and confidentiality of participants in the research study and in the final publication of the findings. Copies of the findings will be made available to you via e-mail.

There are no risks foreseen in the research study. The participants reserve the right to back out of the study at any stage if they so desire.

For further information, correspondence or query about the research study, kindly contact me or my supervisor on the details below:

Thank you for the cooperation.

Mr A.A Obilana

Dr H.O Mokiwa

7.7 Appendix G – Grade 10 science teachers consent form

CONSENT TO PARTICIPANT IN RESEARCH

I_____ (participant name), confirms that Mr Aderemi Obilana asking for my consent to take part in this research has told me the nature, procedure, potential benefits and anticipated inconveniences.

I have read and understood the study as explained in the information sheet. I had sufficient opportunity to ask questions and prepared to participate in the study. I understand that the participation is voluntary and that I am free to withdraw at any time without penalty (if applicable). I am aware that the interviews and lesson presentations will be recorded and grant consent for these recordings. I am aware that the findings of this study will be processed into a research report, journal publications and/or conference proceedings, but that my participation will be kept confidential unless otherwise specified.

Participant's Name (Please print): _____

Participant Signature: _____

Researcher's Name: _____

Researchers' Signature: _____

Date: _____

7.8 Appendix H – Pre-interviews

SEMI-STRUCTURED PRE- INTERVIEW FOR SCIENCE TEACHERS

The science teachers will be interviewed (pre- interview) as follows;

1. What do you want to teach?
2. How will you teach it?
3. How long have you been teaching the subject?
4. Do you specialise in the subject?
5. Do you encounter any challenges in delivering the content, Motivate?
6. What are the challenges you encounter in delivering the content?
7. Do you receive support and assistance on the challenges encountered in delivering the content, motivate?
8. Which part of the subject curriculum did you need support and training in?

7.9 Appendix I – Lesson observation sheet

LESSON OBSERVATION SHEET FOR BOTH PRE-LESSON AND POST-LESSON

CRITERIA	OBSERVATION
1. Use of instructional language.	
2. Subject content knowledge	
3. Teaching strategy	
4. Lesson in aligned with CAPS policy	
5. Developmental flow of the lesson.	
6. Learners involvement/ participation	
7. Use of LTSM	
8. Flow of classroom communication.	
9. Classroom management.	
10. Time management.	

7.10 Appendix J – Post Interviews

SEMI-STRUCTURED POST- INTERVIEW FOR SCIENCE TEACHERS

The science teachers will be interviewed again (post –interview) as follows;

1. What is your view towards the interventional workshops?
2. Does the CPD intervention programme addresses your challenges?
3. What are your perceptions towards CPD programmes as a science teacher?
4. Do you think CPD programmes are needed to enhance your curriculum delivery in your science subject?
5. Do you think as a science teacher CPD will have an impact in your subject curriculum delivery?
6. How often do you think CPD programmes should be conducted?

7.11 Appendix K – An example of pre-interview with T2

PRE-INTERVIEWS WITH T2

- What do you what to teach?

  Response: *I will be teaching organic compound and I will talk about proteins and enzymes.*

- How will you teach it?

  Response: *I am going to use the Life sciences textbook and writes on the chalk board while the learners will listen.*

- How long have you been teaching the subject?

  Response: *4 years*

- Do you specialise in the subject?

  Response: *Yes, I do specialised in the subject.*

- Do you encounter any challenges in delivering the content?

  Response: *Yes. I do not know how to explain the terminologies and vocabularies to the learners, more especially that many of them are not fluent in English language.*

- What are the challenges you encountered in delivering the content?

  Response: *The learners are predominately Sepedi, they are used in speaking their mother tongue. There is no laboratory for science practical hence, the learners are taught theoretically all the time.*

- Do you receive support and assistance on the challenges encountered in delivering the contents?

  Response: *No, there are no support that addresses my concerns.*

- Which part of the subject curriculum do you need support and training in?

Response: *I need to know how to set up the practical activities and which method to use in teaching the learners vocabularies and terminologies without using Sepedi language.*

7.12 Appendix L – An example of pre-lesson observation of T5

CRITERIA	OBSERVATION
1.Use of instructional language.	English language was used as language of instruction.
2.Subject content knowledge	The teacher has content knowledge of the subject.
3.Teaching strategy	Face-to-face instructional method was used. There is direct interaction between the teacher and learners.
4.Lesson in aligned with CAPS policy	Lesson aligned with CAPS policy
5.Developmental flow of the lesson.	The teacher started from abstract to concrete. The lesson was introduced to the learners and explained the body of the content of the topic.
6.Learners involvement/ participation	Learners did not participate in the lesson because the teacher did not give opportunity whereby learners can ask questions, neither did the teacher as well ask questions from the learners to ascertain their understanding.
7.Use of LTSM	Textbook, chalk and board.
8.Flow of classroom communication.	It is only one direction. That's from the teacher to learners only.
9.Classroom management.	The teacher managed the classroom. There was no disturbance from whosoever during the lesson presentation.
10.Time management.	The teacher was able to finish the lesson presentation within the allocated time

7.13 Appendix M – An example of post-interview with T 7

- What is your views towards the intervention workshop?
  Response: *The intervention was highly superb. Highly educative and rich in knowledge, especially working together with colleagues.*

- Does the CPD intervention programme addresses your challenges?
  Response: *The intervention assisted me in my classroom effectively.*

- What are your perceptions towards CPD programmes as a science teacher?
  Response: *Science teachers needs more of this kind of intervention of CPD.*

- Do you think CPD programmes are needed to enhance your curriculum?
  Response: *Like I said, the CPD programme is more needed by science teachers.*

- Do you think as a science teacher CPD will have an impact in your subject curriculum?
  Response: *CPD will definitely have positive impact in subject curriculum delivery if the design of the CPD is planned in such a way that it will caters for our challenges and problems.*

- How often do you think CPD programmes should be conducted?
  Response: *I will be frank; it should be every month.*

7.14 Appendix N –: An example of post-lesson observation of T10

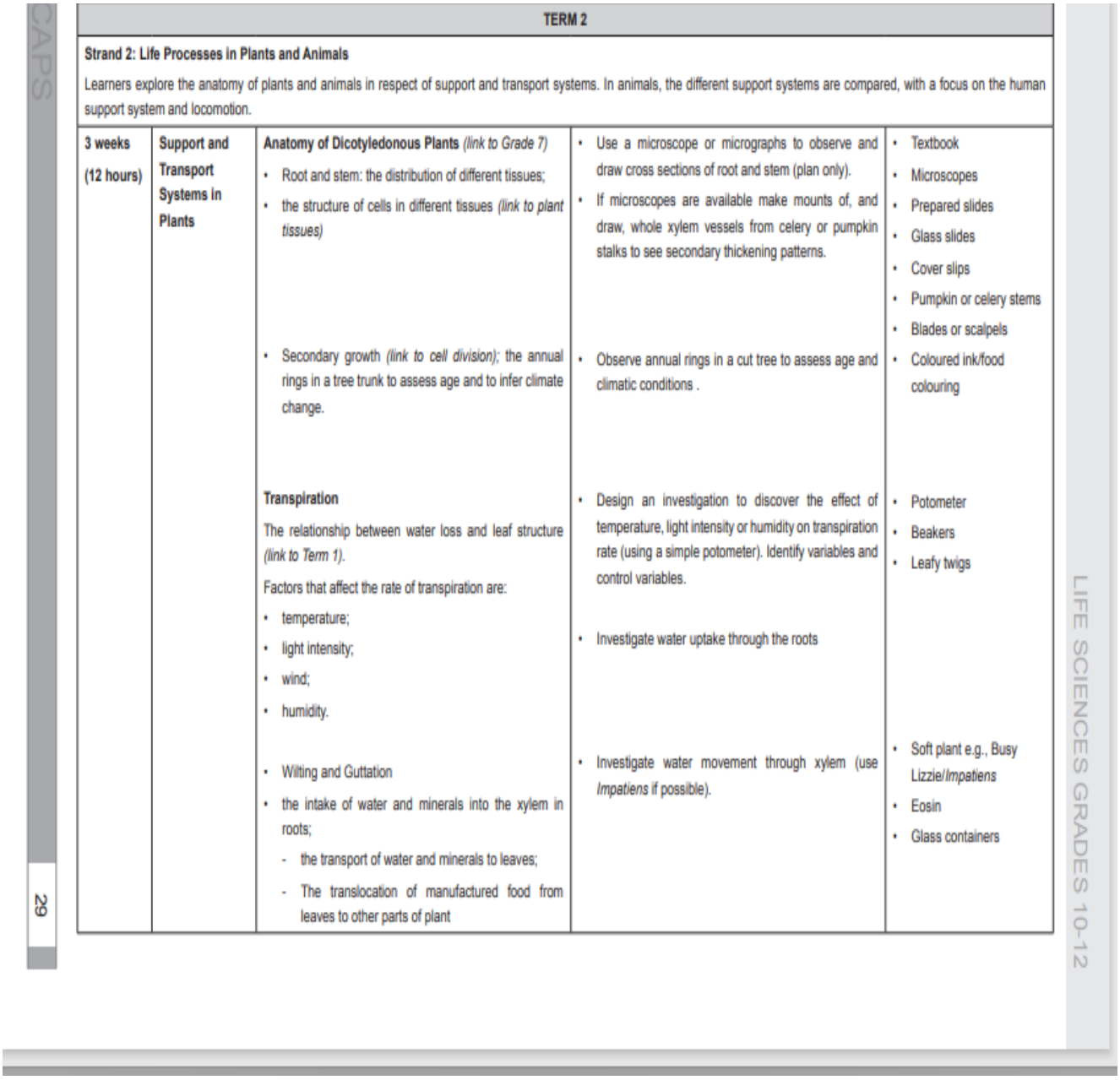
POST-LESSON OBSERVATION SHEET OF T10

CRITERIA	OBSERVATION
1.Use of instructional language.	The teacher used English language throughout the lesson teaching.
2.Subject content knowledge	The teacher showed more knowledge in the lesson presented.
3.Teaching strategy	The teacher made use of some materials to demonstrate simple practical experiments while making reference to the textbook.
4.Lesson in aligned with CAPS policy	Lesson aligned with CAPS policy
5.Developmental flow of the lesson.	The lesson content was introduced to the learners by linking it up to their Grade 9 topic. The teacher recalled their memory to Grade 9 topic. The lesson flow from abstract to concrete.
6.Learners involvement/ participation	Learners participated in the lesson. They asked the teacher questions and even the teacher asked the learners questions as well. Both provided answers. The teacher corrected the learners where they made mistakes.
7.Use of LTSM	Glass cup, razor blade, dye, stem of water plant, textbook, chalk and board.
8.Flow of classroom communication.	It is two ways direction. That's from the teacher to learners and from learners to the teacher.
9.Classroom management.	The teacher managed the classroom even though learners had to sit in groups to attempt some tasks.
10.Time management.	The teacher finished the lesson presentation within the allocated time

7.15 Appendix O – First lesson topic of Grade 10 Life Sciences according to CAPS document

TERM 1				
		Organic Compounds • carbohydrates - monosaccharaides (single sugars), e.g., glucose and fructose; disaccharides, (double sugars), e.g., sucrose and maltose; polysaccharides (many sugars), e.g., starch, cellulose and glycogen; • lipids (fats and oils) - 1 glycerol and 3 fatty acids: unsaturated and saturated fats; cholesterol in foods; and heart disease *(link to Grade 9)*; • proteins - amino acids (C,H, O and N and some have P, S, Fe) - are sensitive to temperature and pH: loss of structure and function; the role of enzymes in breaking down/synthesising molecules; the influence of temperature and pH on enzyme action; the Lock and Key Model of how enzymes work; enzymes in everyday life (for instance using washing powders); • Mention of nucleic acids - DNA and RNA - consisting of C, H, O, N and P (no details of structure required); and • vitamins - e.g., A, one of the B vitamins, C, D and E. *(Simple diagrams to represent molecules. Review briefly why these substances are needed in plants and animals i.e. build on prior knowledge. Do not give detail of structure or function - functions will be dealt with in later sections where appropriate. This is a brief introduction to the molecular make-up of organisms.)*	**Essential:** • Food tests for starch, glucose, lipids and proteins. • Investigate the working of a 'biological' washing powder (containing enzymes). OR • Hydrogen Peroxide and chicken liver to demonstrate the effect of enzymes. OR • Fresh pineapple juice and solid egg white in a plastic drinking straw. AND • Observe, measure and record results of the experiment done at different temperatures. • Compare the Recommended Daily Allowance (RDA) with usual diet of individual learners. Draw a pie chart of the food types and discuss implications of the usual diet of learners.	• Chemicals • Bunsen burners • Thermometers • Washing powder • H_2O_2 and chicken liver or • Pineapple juice, egg white and plastic drinking straws

7.16 Appendix P: Second lesson's topic of Grade 10 Life sciences according to CAPS document



CAPS

TERM 2				
Strand 2: Life Processes in Plants and Animals Learners explore the anatomy of plants and animals in respect of support and transport systems. In animals, the different support systems are compared, with a focus on the human support system and locomotion.				
3 weeks **(12 hours)**	**Support and Transport Systems in Plants**	**Anatomy of Dicotyledonous Plants** *(link to Grade 7)* • Root and stem: the distribution of different tissues; • the structure of cells in different tissues *(link to plant tissues)*	• Use a microscope or micrographs to observe and draw cross sections of root and stem (plan only). • If microscopes are available make mounts of, and draw, whole xylem vessels from celery or pumpkin stalks to see secondary thickening patterns.	• Textbook • Microscopes • Prepared slides • Glass slides • Cover slips • Pumpkin or celery stems • Blades or scalpels
		• Secondary growth *(link to cell division);* the annual rings in a tree trunk to assess age and to infer climate change.	• Observe annual rings in a cut tree to assess age and climatic conditions .	• Coloured ink/food colouring
		Transpiration The relationship between water loss and leaf structure *(link to Term 1).* Factors that affect the rate of transpiration are: • temperature; • light intensity; • wind; • humidity.	• Design an investigation to discover the effect of temperature, light intensity or humidity on transpiration rate (using a simple potometer). Identify variables and control variables. • Investigate water uptake through the roots	• Potometer • Beakers • Leafy twigs
		• Wilting and Guttation • the intake of water and minerals into the xylem in roots; - the transport of water and minerals to leaves; - The translocation of manufactured food from leaves to other parts of plant	• Investigate water movement through xylem (use *Impatiens* if possible).	• Soft plant e.g., Busy Lizzie/*Impatiens* • Eosin • Glass containers

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LIFE SCIENCES GRADES 10-12