PHYSICAL SCIENCES TEACHER ATTRIBUTIONS TO THEIR PEDAGOGICAL PRACTICE AND HOW THEY INFLUENCE THEIR PROFESSIONAL GROWTH IN UMZINYATHI DISTRICT SECONDARY SCHOOLS.

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By

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DECLARATION

The work presented in this thesis is my original work, and all the sources consulted have been acknowledged. This thesis has not been submitted for any degree or examination at any other university.

This study was mandated by an Ethical Clearance issued by the Durban University of Technology Institutional Research Ethics Committee.

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ABSTRACT

Science subjects are critical for any country's economy and South Africa is no exception. The MeerKAT radio station in the Northern Cape, Southern Africa Large Telescope in Sutherland, Northern Cape (largest optical telescope in the Southern hemisphere), and South African Laboratories for Accelerator Based Sciences in the Western Cape are clear testimony of Physical Sciences' contribution to the South African economy. South Africa's Department of Basic Education (2003) stresses that sciences not only prepare learners for economic activity, critical thinking, and problem solving, but also channel them towards applied sciences, medical and engineering fields (Collins and Calhoun 2014; Parker 2017). Thus, sciences set the precedence for success as a stepping stone into prestigious occupations. However, this may only happen if their teachers possess appropriate attributions. Attributions are key to classroom pedagogical practice and learner achievement as they influence teacher pedagogic strategies, choice of materials, content and learner activities. Literature abounds on Physical Sciences teachers, however, questions around their attributions to their pedagogies, have not been adequately investigated. Thus, developing an in-depth understanding of Physical Sciences teacher attributions to their pedagogical practice is vital.

This study explored Grade 12 Physical Sciences teacher attributions to their pedagogical practices and how these attributions shape their professional growth. Through a multiple-site case study within an interpretive paradigm, data were generated from 16 purposively sampled Physical Sciences teachers in selected rural, township and urban secondary schools in KwaZulu-Natal, UMzinyathi district, through face-to-face interviews, document reviews and lesson observations. Data were transcribed and manually analysed through an eight-step open coding process. Two theories – Weiner's (2005) causal attribution theory and Bell and Gilbert's (1996) Aspects of Professional Learning – enabled unpacking, understanding, and explaining the data.

Findings indicate that Physical Sciences teachers attributed their pedagogical practices to both internal and external factors. The teachers attributed pedagogical practices to their internal, unstable and controllable attributions related to professional knowledge (pedagogical and subject content knowledge), which they could manipulate. External and uncontrollable attributions to their pedagogy related to learner ability, infrastructural and material under-resourcing (which forced them to 'make-do'), learner attitudes and family background.

Findings also revealed that Physical Sciences teacher attributions related to networking, improvisation and innovation influenced their professional growth in pedagogical knowledge and practices, pedagogical content knowledge, as well as context and curriculum knowledge.

While the Physical Sciences teachers experienced professional growth, severe under-resourcing in rural schools studied limited their growth. Given the 'make do' frame of mind that teachers adopted, this has a bearing on the teaching and learning of Physical Sciences. This study suggests a need for resource support.

In relation to the theoretical framework, Weiner's Attribution theory and Bell and Gilbert's Aspects of Professional Learning theory in combination make a useful lens to understand attributions to pedagogical practice and teacher professional growth. What I found was that attribution theory on its own was inadequate for understanding attributions and their influence on professional growth. I needed a theoretical way to understand, describe, and analyse data to establish how these attributions influence teacher professional growth. Consequently, Bell and Gilbert's (1996) theory was adopted. This thesis, therefore, suggests a need for more comprehensive research into the nature of Physical Sciences teacher attributions in their pedagogy and their influence on professional growth, drawing on this combined framework and developing it further to determine its applicability beyond this particular inquiry.

DEDICATION

I dedicate this study to my late parents, Ndaba Magwiro Shumba and Rosina Shumba (nee Gumbo), who taught me to persevere and to my late siblings: brothers Tamirira, Gibson and Sostiel, and sisters Silia Makaba, Sithembiso Muhoma and Simbisai Moyo I know you all would have been very proud. Your words of encouragement and push for tenacity are still ringing in my ears. I will remember you always.

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ACRONYMS AND ABBREVIATIONS

ABET	Adult Basic Education Training
ACE	Advanced Certificate in Education
ACT	Advanced Certificate in Teaching
ANOVA	Analysis of Variance
ATP	Annual Teaching Plans
CAPS	Curriculum Assessment Policy Statement
CK	Content Knowledge
CPTD	Continuing Professional Teacher Development
CS	Code Switching
DAS	Developmental Appraisal System
DBE	Department of Basic Education
DoE	Department of Education
DHET	Department of Higher Education and Training
DO	District Office
DR	Document Review
DUT	Durban University of Technology
ECD	Early Childhood Development
ELRC	Education Labour Relations Council
ELSEN	Education for Learners with Special Education Needs
ESL	English Second Language
FAE	Fundamental Attribution Error
FET	Further Education and Training
FFI	Face-to-Face Interview
GCE	Global Campaign for Education
GET	General Education and Training
GPK	General Pedagogical Knowledge

HOD	Head of Department
HSRC	Human Sciences Research Council
IBL	Inquiry Based Learning
INSET	Inservice Education for Teachers
IREC	Institutional Research Ethics Committee
IQMS	Integrated Quality Management System
KZN	KwaZulu-Natal
LO	Lesson Observation
LOLT	Language of Learning and Teaching
MRTEQ	Minimum Requirements for Teacher Education and Qualifications
NCS	National Curriculum Statement
NSC	National Senior Certificate
NSTE	Norms and Standards for Teacher Education
NGOs	Non-governmental Organisations
NPDE	National Professional Diploma in Education
NSE	Norms and Standards for Educators Act
NQF	National Qualifications Framework
OECD	Organisation for Economic Co-operation and Development
OBE	Outcomes Based Education
PCK	Pedagogical Content Knowledge
PGCE	Post-Graduate Certificate in Education
PK	Pedagogical Knowledge
PMS	Performance Management System
PoA	Programme of Assessment
PSC	Professional Standards Council
QMS	Quality Management System
RNCS	Revised National Curriculum Statement

SACE	South African Council for Educators
SALT	Southern Africa Largest Telescope
SASA	South Africa Schools ACT
SCK	Subject Content Knowledge
SDGs	Sustainable Development Goals
SMT	School Management Team
SPK	Subject Pedagogical Knowledge
TIMSS	Trends in International Mathematics and Science Study
UK	United Kingdom
USA	United States of America
WSE	Whole School Evaluation

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CHAPTER ONE

INTRODUCTION TO THE STUDY

Introduction

Attributions are the explanations or reasons that teachers give for their or other people's actions, behaviour, feelings, attitudes, beliefs, skills and knowledge about their teaching and learning experiences (Weiner 2005). In other words, these are the basis for the teachers' classroom and pedagogical choices, decisions and actions. Consequently, attributions are critical to teacher professional practice as they shape their decisions and choices on instructional behaviours, processes and tasks. The study sought to develop an in-depth understanding of Physical Sciences teacher attributions to their pedagogy and how the attributions influence their professional growth in the UMzinyathi district of South Africa. This chapter attempts to set the scene for the study by providing vital preliminary contextual information and articulating the problem.

Literature (Borg 2003) shows that teacher attributions to teaching and learning have a great impact on pedagogical practice and teacher growth as they can either promote or inhibit their practice and their development. Karabenick and Conley (2011) assert that there is a strong link between teacher attributions and professional growth and the latter is essential for instructional effectiveness and improvement of students' learning and achievement. Further reviewed literature (Farrell and Ives 2015) also shows that teachers' attributions to teaching not only affect their teaching practices but also their development and students' learning and progress. National literature (Steyn 2010) further indicates that attributions play an important role in teacher professional learning and development processes.

South Africa as a developing country has potential for great achievement in the science and technology areas which contribute to national economic growth (Kelder 2008). Science related projects like the South African MeerKAT radio station launched in 2018 in the Northern Cape, the Southern African Large Telescope (SALT) in Sutherland (the largest optical telescope in the Southern hemisphere), and the iThemba LABS (South African Laboratories for Accelerator Based Sciences) in the Western Cape are testimonies of the value of the sciences and their contribution to the country's economy (Sooryamoorthy 2013; von der Heyden et al. 2016; Maree and Vos 2021). Further, the study of Physical Sciences contributes towards the holistic development of learners in professional career paths related to applied science courses and

medical and engineering fields (Collins and Calhoun 2014; Parker 2017). This is further illustrated by Okoye (2009) who says science education is also valued in society as it sets the precedence for academic success as the stepping stone for entrance into more prestigious occupations.

Additional literature consulted further emphasises that Mathematics and Science are two gatekeeper subjects required to sustain a nation's economy (Ogunniyi 2011). The Global Campaign for Education (GCE) in outlining the Sustainable Development Goals (SDG) for 2030 emphasises that science learners must be equipped with transferable skills, such as problem solving, critical thinking and creativity as they are key skills for economic growth and environmental sustainability (UNESCO 2020). Ingersoll and Perda (2009) reveal that contemporary educational thought the world over holds that one of the pivotal causes of inadequate learner performance is the inability of schools to adequately staff classrooms with qualified teachers, particularly in the fields of science and mathematics. They go on to say shortages of science and mathematics teachers are at the root of staffing problems and these shortfalls generally affect education quality. SACE (2010) indicates that science and mathematics teacher demand and supply, both internationally and in South Africa, is a complicated set of dynamics which has contributed to poor learner performance. In this regard, the Department of Basic Education (DBE) (2003; 2015), also emphasising the value of the sciences, stresses that these subjects prepare learners for active national economic activity, critical thinking, problem solving, self-expression, acting responsibly towards the environment and developing alternatives in difficult situations. Consequently, DBE Action Plan 2017 to 2019, foregrounds an "increase in the number of learners who pass Physical Sciences" (DBE 2017:21).

However, students can only develop those requisite skills, competencies and qualities that would channel them to the science-related fields outlined above when their teachers possess appropriate attributions inter alia. Thus, developing a little more understanding of Physical Sciences teacher attributions to their pedagogical practices and the influence of those attributions on their professional growth is vital. In addition, investigating teacher attributions enables an exploration of issues that intersect with the bigger debates about on-going supply-side deficits of science and mathematics teachers and specialists to enhance economic development, as well as discourses around Physical Sciences teacher practice and professional growth.

Studies of teacher attributions have been carried out internationally (see, for example, Adams 2012; Petrie 2013; Riley and Ungerleider 2012), regionally (Kafyulilo 2013; Lyakurwa 2012; Wesonga and Aurah 2019) and nationally (Gudyanga and Jita 2019; Motloung, Mavuru and McNaught 2021; Ramnarain and Hlatswayo 2018). However, questions regarding the nature of teacher attributions to their pedagogical practices and their influence on professional growth remain unanswered as none of the studies surveyed investigated this phenomenon. This is what this study aims to contribute in a limited way. There is evidence (Weiner 2005) that internal attributions are unstable and controllable, implying that they can change over time, while external attributions are stable and uncontrollable, which means these cannot be changed easily.

The sample of teachers investigated in this enquiry were qualified Physical Sciences teachers practising in selected rural, urban and township schools in the UMzinyathi district in the KwaZulu-Natal (KZN) Province of South Africa. This interaction, therefore, lifts the specifics of these sixteen teachers that form the heart of this study into the wider discourses on teacher practice and student learning of science. Thus, this study is not only about understanding the sixteen teachers explored. Further, while the teachers investigated in this study were not fully representative of all Physical Sciences teachers due to philosophical orientations and assumptions, and the small sample size, they exemplify teachers working in rural, urban and township contexts teaching this subject. As such, findings may shed some light on issues that are pertinent to the wider context.

Following this introduction, a background of the study which offers a synopsis of the history of teacher education in South Africa and the policy context is provided. Subsequently, I define the focus and purpose of the study, which is followed by my personal context and motivation, my axiological assumptions and the rationale behind the study. Thereafter, I outline the statement of the problem and research questions. Overviews of theoretical frameworks and methodological approaches are then provided, followed by the definition of terms. The thesis organisation is then outlined to conclude the chapter.

Background to the study

This section offers a synopsis of the history of teacher education in South Africa and then discusses the policy context of the study.

A Synopsis of the History of Teacher Education in South Africa: Pre-Liberation Era

Under apartheid, the entire education system of South Africa was divided into four groups. Coetzee (2010:1) states that from "1948–1994 the Department of National Education under the National Party Government created four separate departments of education for each of the designated race groups". These were the Department of Education and Culture in the House of Representatives for coloured learners; the Department of Education and (Teacher) Training for blacks; the Department of Education and Culture in the House of delegates for Indians; and the Department of Education and Culture in the House of Assembly for whites (Mukeredzi 2009; Wolhuter, Lemmer et al., 2007; South Africa.info 2006). This segregation of departments according to race promoted inequality across the South African education and teacher education setting. There were glaring differences and inequalities across the four education systems in South Africa and this applied to teacher qualifications, teacher-pupil ratios, per capita funding, buildings, equipment, facilities, books and stationery. Resourcing was determined and classified on racial lines, with blacks enduring a bleak and resource deprived education system, while education for whites was rich and comfortable, and that for Indians and Coloureds satisfactorily provided for (Islam 2012; Mukeredzi 2009; Wolhuter, Lemmer et al. 2007).

Further, in teacher education, teachers were trained in racially and ethnically segregated colleges and universities (Islam 2012). Teacher education for whites was located in post-matriculation whites-only colleges and universities (Cross and Chisholm 1990). Post-matriculation institutions were those institutions attended by students who had passed matric examinations known as the National Senior Certificate (NSC). The entrance requirements in these 'whites only' institutions were prohibitive for other races. The programme duration was four years for a teachers' diploma and three years for a degree (Chisholm 2019). The duration was longer for a teachers' diploma because it involved a practical element which the degree did not.

South African black students and student teachers disliked Bantu Education as the majority of them considered it inferior to the alternative offered to their white counterparts. It was a symbol of their position in the wider society, further depriving them of opportunities (Ilorah 2006). Chisholm (2019) explains that the aim of Bantu Teacher Education was to prepare teachers for the rapidly increasing number of primary schools. The responsibility of educating black South Africans lay under the Department of Bantu Education and, later, the homeland governments

assumed control of teacher training colleges within their areas, which were basically extensions of the schooling system (Chisholm 2020).

Parker (2003:20) asserts that there were huge and evident variations in the provinces and homelands and many shortcomings emerged in the apartheid teacher education system, including:

- Numerous varied curricula and qualifications;
- The absence of nationally coordinated teacher supply and demand;
- Ineffective quality assurance and accountability procedures;
- Varied per capita costs and serious distortions in supply; and
- An abnormally large pool of unemployed primary school teachers (50 000) and a serious shortage of secondary school Science teachers.

Preceding 1963, each province had different teacher education courses/curricula and teachers' qualifications or certificates. There were differences in the nature and structure of curricula and qualifications as each training college pursued its own provincial curricula and qualifications (Chisholm 2020; Mukeredzi 2009). In other words, due to these differences, teacher training in segregated provincial homeland colleges did not permit teachers to teach in other provinces. The then-prime minister of South Africa, Hendrik Verwoerd, pointed out that Indian and coloured people were to serve their communities in a natural way (HSRC 2005). In other words, Indian teachers were required to teach Indian children and coloured teachers to teach coloured children, as it was then assumed that mixing across race groups was unnatural, hence 'separate development'. Apart from segregation, teacher education portrayed a complex system that was unequal and inefficient, fragmented and expensive, characterised by glaring cost discrepancies across institutions (Chisholm 2020; Maistry 2014; Mukeredzi 2009).

In the 1940s, South African teacher training colleges generally offered diverse programmes:

1. Teachers' Lower Certificate and Senior Certificates with entry qualification requirement of Standard X;
2. Two-year primary school teachers' lower course after Standard VIII;
3. Two-year primary school teachers' course after Standard X; and

4. Higher primary school teachers' course specialisation for teachers with either one or two of the other certificates above. (Chisholm 2019).

The two-year primary school teacher lower course was restricted to women (Chisholm 2019). However, there is no evidence of any programmes that were crafted to further enhance teacher professional growth. According to Mukeredzi (2009), in the 1940s, rationalisation, reorganisation, and redeployment processes in teacher training colleges became even more critical.

Teacher Education in South Africa: Post-Liberation Era

On gaining liberation, the government embarked on rationalisation and the establishment of provincial government departments, instituting radical structural transformation which shifted teacher education from provincial governance to national competence in 1996 to rationalise and regularise curricula and qualifications (Chisholm 2020; Maistry 2005; Parker 2003; Mukeredzi 2009; 2016; Ogunniyi and Mushayikwa 2015). Amid all these changes, there was a marked decline in enrolments of student teachers registered in colleges and university Faculties of Education (Parker 2003) mainly due to issues related to relevance and quality of the many offerings, as well as inconsistencies and apparent lack of regulation. These were pointers to the need for the incorporation of these colleges as sub-divisions of the then existing universities as opposed to autonomous colleges (Parker 2003). Thus, the post-1994 democratic government decided to institute the incorporation of teacher education colleges into the then existing Higher Education Institutions (HEIs) and the closure of all teacher training colleges (Chisholm 2019; Mukeredzi 2009; Parker 2003).

Soon after the publication of the Teacher Audit in 1995, the government embarked on these proceedings to rationalise the teaching profession by closing teachers' training colleges and offering 'excess teachers' severance packages as a way of addressing the question of 'over-supply' and 'under-supply'. Consequently, following the implementation of the Constitution in 1996, colleges of education became the responsibility of higher education, incorporated into universities (Sayed 2004). The university sector became the main provider of both primary and secondary teacher education.

The decision to locate teacher education in universities had to do with 'a strong focus on 'subject/learning area content knowledge' and a research culture which universities rather than colleges were seen to provide' (Sayed 2004). In making universities responsible for teacher education and not provincial departments, 'a degree of autonomy that universities enjoy,

including curriculum autonomy' was secured (Sayed 2004:287). The teacher education programmes offered, among others, included a four-year Bachelor of Education (BEd) and a one-year Postgraduate Certificate in Education (PGCE), following a three-year degree (Chisholm 2019). Apart from a set of 'core' or 'foundation' modules that all student teachers had to take, student teachers had subject specialisations and one of those specialisations was Physical Sciences. It is the nature of attributions to pedagogical practices of a group of teachers who specialised in Physical Sciences that this study investigated.

However, in those processes of incorporation there were challenges, related to teacher shortages which were more intensified in rural than in urban schools given that, as Lewin, Samuel et al. (2003) point out, there was urban teacher oversupply and rural teacher undersupply. Physical Sciences subjects were not spared. Parker (2003) indicates that the system created a shortage of secondary school Science teachers and those who were hired to teach the subject were professionally unqualified with gross content gaps. Thus, the nature of the teachers' attributions to their pedagogical practices and how they influenced their professional growth needed to be understood and documented. Given the knowledge gaps as highlighted above, between 2001 and 2014 the Department of Education (DoE) focused on teacher in-servicing, upgrading and/or re-skilling, targeting the many underqualified or unqualified serving teachers and unemployed educators who required retraining in preparation for employment (Parker 2003; Sibanda and Mukeredzi 2019).

One of such upgrading programmes launched by the DoE was the Advanced Certificate in Education (ACE). The ACE was intended to 'cap' an initial or general teaching qualification, through which graduates were able to proceed with studies at NQF Level 7 (CHE 2010). Physical Sciences was one of the specialisations within this suite of ACE programmes launched by the government. The ACE Physical Sciences programme, introduced in response to poor teacher quality in science (Spaull 2013), was offered to candidates who already possessed an NQF Level 6 teacher qualification and were teaching Physical Sciences at high school, to develop their content knowledge and practical skills for teaching in the Further Education and Training phase (FET) (Sibanda and Mukeredzi 2019). But, whether or not the Physical Sciences teachers attributed their pedagogical practices to such programmes and how the attributions influenced their professional growth, was not known. This is what the study sought to establish.

Having chronicled in the section above the post-Liberation history of teacher education in South Africa, the next section discusses the South African policy context related to teacher education.

South African Education Policy Context

In its endeavour to dismantle the unpopular apartheid educational system in South Africa upon attaining liberation, the DoE formulated a number of education policy initiatives.

Curriculum 2005 (C2005) and Outcome Based Education (OBE) formulated in July 1994 with its implementation in 1998 was regarded as the master plan to eradicate the inequalities of the apartheid education system (Deventer 2009). Deventer goes further to say C2005 was viewed as a planned framework (process) of curriculum innovation underpinned by factors such as redress, access, equity and development. Key points enshrined in this new curriculum included instilling a sense of co-operation, critical thinking and social responsibility, as well as empowering individuals to participate in all aspects of society (Deventer 2009). Further, C2005 took into consideration all forms of education such as Early Childhood Development (ECD), General Education and Training (GET), Further Education and Training (FET), Adult Basic Education and Training (ABET), Education for Learners with Special Education Needs (ELSEN) and Inservice Education for Teachers (INSET) (Chisholm 2019). As a democratic approach, teachers were considered as equal partners in curriculum and material development with employers (Cross, Klein and Twala-Mkwanazi 1998). The curriculum emphasised outcomes (such as the acquiring of skills and grasping of the subject matter and the content) that were to be achieved by the learner. C2005 also emphasised the Norms and Standards for Teacher Education (NSTE) of 1997 and 2000 which provided the basis for what is expected of a competent teacher (these are outlined in the next section).

While this Curriculum C2005 offered a breakthrough in terms of addressing imbalances of the past, one of its shortcomings was failure to choose a common language for teaching and learning. (Parker 2003). Further C2005's over-emphasis on Christian/European education was considered unrealistic in many regions of South Africa (Enslin et al. 1998). Ono and Ferreira (2010:59) also point out that, "The introduction of Outcome Based Education (OBE) and Curriculum 2005 (C2005) was an unprecedented curriculum reform in the history of South Africa". This OBE and C2005 reform created a huge gap between its aims and what the majority of teachers were trained for (Jansen and Taylor 2003). OBE was very different from what teachers were accustomed to: as such, what was required was both intensive and extensive

teacher professional development (Fiske and Ladd 2004). However, training of teachers for OBE was shoddy and inadequate (Jansen and Taylor 2003). Steyn (2008) concurs that the South African education system can only be transformed if teachers are appropriately equipped to meet the policy delivery challenges in the classroom. Instead, the DoE mounted 'multiplier' cascade models of teacher training (Ono and Ferreira 2010) which were ineffective as some trainers did not understand the curriculum and, consequently, distorted crucial information (Mukeredzi 2009). As such the training did not translate into desired teacher practices in their classrooms. Villegas-Reimers (2003) emphasises that professional learning and development are basic and critical in implementing educational reforms. With these and other weaknesses, the C2005 outcomes-based curriculum was discontinued.

In an attempt to promote teacher professional growth, in 1995 the regulatory framework for teacher education programmes developed by a South African committee of experts was established (Human Sciences Research Council (HSRC) South Africa 2006). The framework, was published and scheduled for discussion in 1998 and later gazetted as the Norms and Standards for Educators Act (NSE) in 2000 (South Africa DoE 2005; Department of Higher Education and Training (DHET) 2010). The policy outlined the values, knowledge and skills that were viewed as symbolic of a professional and knowledgeable educator. The aim was to develop knowledgeable, highly skilled and valued teachers, capable of implementing C2005. It provided an overall strategy for effective teacher professional growth and development, teacher retention and student recruitment, to meet social and economic needs. This policy, which catered for all teachers in all Phases (from Foundation Phase to FET), intended to build a community of committed, competent and highly efficient, ethical, and professional teachers critical to the provision of quality education (Mukeredzi 2009). The seven prescribed roles for educators as outlined in the NSE policy called on the teacher to be:

I. The specialist in a phase, subject discipline, or practice;

II. The learning mediator;

III. An interpreter and designer of learning programmes and materials;

IV. A leader, administrator, and manager;

V. A scholar, researcher, and life-long learner;

VI. An assessor; and

VII. Engaged in community, citizenship, and pastoral roles (DHET 2010:51-52).

The policy was also intended to provide teacher educators with a guide regarding what to include when designing teacher education programmes (DHET 2010). However, Parker (2001) argues that the relationship between policy processes for teacher education, what happens in teacher education programmes in universities and teacher development in the classroom (student learning) was not established. Given this argument, understanding how and whether the Physical Sciences teachers' attributions influenced teacher professional growth needed to be established.

In a bid to transform and improve the quality of education, the DoE introduced the Revised National Curriculum Statement (RNCS) in 2002 which was built on the previous curricula (C2005) with the aim of updating and specifying more clearly what was to be taught and learnt on a term-by-term basis (Chisholm 2019). However, between 2002 and 2009, the RNCS was criticised for its lack of specification. In 2009 it was reviewed, then revised and in 2012 replaced by the Curriculum and Assessment Policy Statements (CAPS) which was adopted and is currently operational.

CAPS' introduction came with a significant focus on the course content, teaching and learning pedagogy and learning strategies (Ojo and Mathabathe 2021). Further, the curriculum was meant to assist learner knowledge and skills acquisition and give teachers a structure on what to teach and assess on a grade-by-grade and subject-by-subject basis, thereby creating uniformity in the system (Ojo and Mathabathe 2021). With the introduction of CAPS, the government tried to close the existing gap between private and public schools (Chisholm 2019). Most private schools form part of the IEB (Independent Examinations Board) (DBE 2020), an agency that provides examinations to most private schools. The IEB also follows the CAPS curriculum like any other public school. Thus, the educational gap between private and public schools led the government to introduce CAPS to close the gap between IEB students and public school students, to merge the inequality gap (Ojo and Mathabathe 2021).

However, Ojo and Mathabathe (2021) argue that CAPS as a nationwide curriculum has benefited private schools more than public schools. The reason is that although most private schools offer an IEB curriculum, they have better resources and facilities and employ qualified and experienced teachers (Ojo and Mathabathe 2021) who know and understand the curriculum subjects better than public school teachers and provide integrated learning and teaching in each learning area offered. Given this argument, investigating public school Physical Sciences

teacher attributions, delivering the CAPS curriculum was vital. While CAPS is currently operational, there are other policy initiatives that were launched to run concurrent with it: Integrated Quality Management System; South African Council for Educators CPTD; and teacher subject clusters which I discuss below.

Further promoting on-going teacher professional growth, the South African DBE introduced the Integrated Quality Management System (IQMS) in 2003 and later reviewed and changed it to the Quality Management System (QMS) in 2021 (DBE 2022).

The IQMS, which embraced three integrated systems, namely, the Developmental Appraisal System (DAS), Whole School Evaluation (WSE) and the Performance Management System (PMS), aimed at identifying the specific needs of teachers, schools and district offices; providing support for continued professional growth; promoting accountability; monitoring an institution's overall effectiveness; and evaluating teachers' performance (Education Labour Relations Council [ELRC] 2003). The policy assumes that most teachers recognise the need for and take responsibility for personal professional growth. Hence, establishing the influence of teacher attributions to their professional growth is synonymous with determining teacher responsibility for their professional growth. While DAS enables transparent individual teacher appraisal with a view to determining areas of strength and weakness, in order to draw up programmes for individual improvement (ELRC 2004), WSE was intended to institute the effective monitoring and evaluation of teaching and learning and the vital enhancement of quality and standard of performance in schools (Steyn 2017). PMS, an aspect of accountability systems, is a supportive structure within the schools where teachers are supposed to be assisted by their supervisors to attain the standards expected of them (Mosoge and Pilane 2014). Thus, IQMS was meant to monitor teacher professional growth and the quality of teaching and learning in all schools in South Africa from FP to FET. One of its objectives was regulation of educator competencies and evaluation of their strengths and professional growth and development needs (DoE 2002b). However, such growth would only occur if the educators possessed appropriate attributions, given that teacher professional learning and consequently professional growth only occurs when they are open to that learning (Guskey 2004). The ELRC (2003:1) training document states that "the IQMS intends to identify the professional growth needs of teachers and schools to support them and enhance their development and continuous growth". However, Mahlaela (2011:2) asserts that "most schools' management and teachers had a negative attitude towards the policy as they believed that the purpose of the IQMS was to determine salary progression and exercise control. They also viewed IQMS as an instrument

used by the DBE which had no benefit to schools' internal management." With all these arguments, whether Physical Sciences teacher attributions influenced them to professionally learn and grow through such instruments needed to be understood and recorded.

Another policy initiative for teacher professional growth relates to the Continuing Professional Teacher Development (CPTD) mentioned above, developed by the South African Council for Educators (SACE). The SACE is a statutory body for professional educators, which initiated a CPTD system (DoE 2006). It is a recognised body for educators, entrusted with the responsibility to register all educators, manage professional learning and development for educators and instil a code of ethics among them (Mokgalane 2019). Through the CPTD system all educators (from FP to FET) would earn professional learning and development points by engaging in activities that addressed their own professional growth needs from the endorsed SACE list. Teachers would choose from: "school driven programmes; employer driven programmes; qualification driven programmes; and programmes offered by Non-Governmental Organizations (NGOs), teacher unions, community-based and faith-based organisations or private companies" (DoE 2006:18). A disciplinary measure that "teachers who did not achieve a minimum number of professional development points over two successive cycles of three years would be accountable to SACE for such failure" (DoE 2007: 20) is included. This CPTD programme threatens to deregister teachers who do not accumulate the prerequisite 150 points in a three-year cycle (Mokgalane 2019; SACE 2013). However, Mosope and Pilane (2014) complain that associating professional learning with monetary incentives pressurises teachers to learn or to cheat the system in order to financially benefit. There is no evidence of the effectiveness of the system or the consequences of poor performance (Steyn 2017). Hence, this study sought to understand whether, what and how the Physical Sciences teacher professional growth took place as a result of some of these initiatives.

Another initiative that was launched in South Africa in 2009 (and 2012 in KZN) as an intervention to promote teacher professional growth and improve learner performance was through teacher subject clusters (Magnaye-Laylo 2020). A cluster is a group of schools within the same geographical location that regularly converge to promote their own and others' professional learning through sharing ideas, resources, pedagogies and problems which ultimately may improve education quality and relevance in their respective institutions (Mukeredzi 2016). Therefore, all curriculum subject teachers belonged to their different subject clusters which met regularly to learn from and with each other. Clusters stimulate collaboration and networking and advocates of this approach (Cheetham and Chivers 2001; Kwakman 2003;

McDonald and Klein 2013; Middlewood, Parker and Beere 2013) assert that it enhances teacher professional growth. However, Jita and Mokhele (2014) point out that there is no evidence of the effectiveness of this model of teacher professional learning and growth. From the various policy initiatives for promoting teacher professional learning and growth, as well as learner achievement established by the South Africa education system discussed above, whether or not the attributions of teachers broadly, and Physical Sciences teachers in particular, influenced their professional growth through these policy avenues needed to be investigated. In the next section I discuss the state of teaching and learning Physical Sciences in South Africa.

The Context of Teaching and Learning Physical Sciences in South Africa

Physical Sciences is taught from Grade 10 to Grade 12 (FET Phase) and is comprised of two sections: physics and chemistry. At the time of this research, for assessment each section contributed 50% of the final grade. During assessment practical work was integrated with theory to strengthen the concepts being taught (CAPS 2011). The practicals were in the form of simple practical demonstrations, experiments or practical investigations done by learners under the supervision of the teacher. Formal assessment for learners in Grades 10 and 11 comprised of two prescribed experiments per year, one Physics experiment and one Chemistry experiment (one experiment per term in Terms 1 and 2). Grade 12 had three prescribed experiments per year, one or two Physics experiments and one or two Chemistry experiments (one experiment per term in Terms 1, 2 and 3). Two control tests and two examinations were written as formal assessment in each of Grades 10 and 11. One control test, one midyear examination, one trial examination and one final examination were written as formal assessment for Grade 12. There were four recommended informal experiments for Grades 10 and 11 and three recommended for Grade 12 (CAPS 2011). All these forms of assessment were meant to equip learners with the requisite scientific skills. However, practical lessons in many South African Schools, in particular in rural schools, were not conducted due to lack of both infrastructural and materials resources. This is confirmed by Umalusi, the South African Examinations Board responsible for quality control in the schooling system, who lament that the prescribed practicals require specialised equipment that most schools do not have. As a result these schools skip practicals (Grussendorff et al. 2014). It was further noted that most of the schools in the country (95%) were not able to implement these prescribed practical components of CAPS due to inadequate laboratory facilities (Grussendorff et al. 2014).

This is not withstanding that an overview of Physical Sciences portrays the subject as a hands-on subject with a lot of practical laboratory components or practical skills that learners must learn (Fitzgerald, Danaia and McKinnon 2017). Justifying practical work in science education, Jenkins (1999) points out that it is only through practical laboratory work that learners get real experience about the natural world. The DBE (2021) in their diagnostic report on Physical Sciences (November 2021 examination), emphasised that practical work needs more attention in schools to ensure that learners are able to apply practical skills, such as identification of variables, drawing of conclusions, interpretation of results and drawing and interpretation of graphs. Recent studies (Tsakeni 2018; Ramnarain and Hlatswayo 2018) on reforms in the practical components of science curricula have been characterised by an emphasis on inquiry-based learning which is only possible with the availability of material. In the absence of resources, teacher attributions are supposed to come into play to enable initiative and creativity to enhance fruitful preparation and delivery of lessons.

Challenges around the teaching of Physical Sciences in South Africa are well documented. However, lack of resources (Makgato and Mli 2006; Ramnarain and Hlatswayo 2018; Grussendorff 2014) such as laboratory apparatus has a negative effect on teaching and learning. Further to this, the same studies indicate that the apartheid hang-over still affects the state of education including the teaching and learning of Physical Sciences. Makgato and Mli (2006) and Ramnarain and Hlatswayo (2018) concur that there is unequal distribution of resources and unequal conditions of schools, including the availability of learning materials in classrooms. Most rural schools suffer from lack of physical resources such as laboratories as compared to their urban conterparts. Consequently, performance of learners in Physical Sciences located in these marginalised contexts such as UMzinyathi district, which is predominantly rural (STATS 2016), is lower compared to learners in urban settings. As such many learners lose out on practical lessons and demonstrations in Physical Sciences which are meant to stimulate their curiosity, deepen their interest in the natural and physical world in which they live and guide them to reflect on the universe (DBE 2011). Given the lack of resources, it means that the teaching of Physical Sciences remains at a theoretical level even though the teachers may draw on their attributions.

In addition to limited resources, lack of Subject Content Knowledge, (SCK) among South African teachers is also documented (Appleton 2015; Bertram, Mthiyane and Mukeredzi 2013; Oduaran and Bechuke 2018) and Physical Sciences teachers are not an exception. Lack of SCK in some topics implies that learners will not be able to acquire the content and skills related to

scientific knowledge and scientific literacy (DBE 2011) as prescribed in CAPS (2011). A comment in the Diagnostic Report for the November 2021 Physical Sciences examinations indicates that in many questions, candidates made "the same errors and displayed the same poor conceptual understanding as in previous years" (DBE Diagnostic Report 2021:212). This comment summarises the context of Physical Sciences. If different candidates portray the same poor conceptual understanding in consecutive years, this could be attributed to teacher gaps in Subject Content Knowledge (SCK), Pedagogical Content Knowledge (PCK), Pedagogical Knowledge (PK) and/or poor pedagogical practices. In such situations, one wonders to what the Physical Sciences teachers attribute their pedagogical practices and whether those attributions influence their practice. In addition, Physical Sciences is a practical subject which requires scientific demonstrations, practical learner engagement, problem solving and good learner/teacher interaction. Research (DBE 2009; Makgato and Mli 2006) has shown that apart from under-resourcing, in most schools Physical Sciences teaching is rendered ineffective by large classes.

Another aspect which impacts the teaching and learning of Physical Sciences relates to learner negative attitudes towards the subject as has been documented (Gough 2014; Duit, Niedderer and Schecker 2015). The same sources concur that some learners have a general fear of the subject, treating it as very difficult. From the current state of Physical Sciences, it remains to be established whether or not the Physical Sciences teachers in this study also attributed their pedagogical practices to this and other factors alluded to above and how the attributions influenced their professional growth. The next section discusses the focus and purpose of the study.

Focus and Purpose of the Study

The focus of this case study was to understand the nature of Physical Sciences teacher attributions to their pedagogical practices in rural, township and urban schools in the UMzinyathi district of KZN Province, South Africa. The study also investigated how these Physical Sciences teachers' attributions influence their practices. In South Africa Physical Sciences is taught from Grade 10 to Grade12 as highlighted above. The Physical Sciences teachers targeted by this study are those teachers who were teaching the subject in Grade12, excluding teachers who were teaching the subject in other Grades. In South Africa, school learning is divided into four phases: Foundation Phase (Grade R to Grade 3), Intermediate Phase (Grade 4 to Grade 6), Senior Phase (Grade 7 to Grade 9) and FET Phase (Grade 10 to

Grade 12). As can be noted, FET is the last or highest phase in the schooling system and the matric results are analysed and measured based on the Grade 12 results (Roodt 2018). It was this focus on Grade 12 as a measure for matric performance and entry into higher education that motivated an investigation related to this grade.

In the Trends in International Mathematics and Science Study (TIMSS), performance of South African learners was ranked number 48 of the 49 countries that participated (TIMSS 2015). In the same year the Organisation for Economic Co-operation and Development (OECD) released a report ranking the education systems of 76 participant countries across the globe based on science and mathematics, and South Africa was ranked the 75th the worst science and mathematics education country out of 76 countries (Roodt 2018). This poor ranking of South African learner performance in science and mathematics by two different independent international bodies is worrisome. In addition, while tests and assessments have been conducted with learners, content gaps in science and mathematics among South African teachers have been documented as highlighted above (also see for example Bertram, Mthiyane and Naidoo 2021; Bloch 2009; Fleisch 2008; Green et al. 2011; South African DBE 2017; Mukeredzi 2013; Taylor et al. 2019). Therefore, against this background, the focus of the study was to explore Grade 12 Physical Sciences teacher attributions to their pedagogical practices given the strong link between teacher pedagogy and learner performance and outcomes (Costa et al. 2015; Jacob, Sakiyo and Gwany 2020) .

While urban schools are often well-resourced, rural and township schools are generally acutely under-resourced (Moletsane 2012; Hugo, Jack, Wedekind and Wilson 2010) which prompts the teachers to "make-do" (Mukeredzi 2009). Teachers are, thus, forced to draw on their attributions and creativity to utilise whatever resources are available within their environment to deliver effective lessons. Given this situation, the purpose of the study was to establish whether teachers in such contexts attribute their pedagogical practices to those external factors and, if so, how the attributions influence their professional growth. Mukeredzi (2013) posits that the shortage of resources in marginalised contexts may awaken the teachers' ingenuity which then feeds into their professional growth. She further contends that such limitations challenge teachers to think creatively, drawing on their attributions, thereby enabling professional growth to occur notwithstanding the constraints. It is Physical Sciences Grade 12 teachers teaching in rural, township and a few urban schools whose attributions to pedagogical practices and their influence on their professional growth, who were the focus of this study.

Teacher attributions as alluded to above can be either internal (unstable and controllable) or external (stable and uncontrollable) (Weiner 2005). This study set out to understand both types of attributions to teacher classroom practice. The purpose of this study was, therefore, to develop an in-depth understanding of the nature of attributions the Physical Sciences Grade 12 teachers had to their classroom pedagogies. The study sought to get behind their 'faces and skins' (Bhengu 2005) to understand, through 'their eyes' and 'stories' (Mukeredzi 2009) their attributions and how they influence their professional growth. Data generation, therefore, attempted to extract responses indicating the nature of these teachers' attributions to pedagogical practice and their impact on their professional growth. The next section discusses my personal context and motivation for this study.

Personal Context and Motivation for the Study

I grew up in a rural area and did my primary and secondary education in rural schools. My interest in science education dates back to my secondary education in Form 1 (equivalent to South African Grade 8) where my role model then was my science teacher Mr Nyama (pseudonym). By then Zimbabwe had just attained independence and most rural schools were poorly equipped, with no science laboratory, no electricity, no piped water and the majority of teachers were not trained. During science lessons Mr Nyama would demonstrate using any available resource at his disposal and would say: "*suppose this is a beaker, and suppose this is a spatula, and suppose this is a Bunsen burner*". All science learning was abstract because almost everything was a 'supposition' but I still enjoyed learning science and the subject became my favourite.

It was only when I was doing 'O' Level (also known as Form 4 in Zimbabwe and equivalent to the South African Grade 11) when we got exposed to actual science practicals, but still with limited resources. However, despite the challenges associated with rurality, I experienced good teaching and learning throughout school education. In my life as a teacher, I have regularly reflected on and replayed my learning experiences, trying to understand what my teachers attributed their science teaching to and how they managed to teach effectively in marginalised environments. There is evidence (see for example Arnold 2005; Moletsane 2012; Mukeredzi 2016) that schools in rural contexts the world over face challenges but still produce results under those unfavourable conditions. A replay of my experiences, where I always wondered what my own primary and secondary school teachers attributed their pedagogical practices to,

stimulated me to try to understand the nature of those secondary Physical Sciences teachers' attributions to their pedagogy and their influence on their professional growth.

After training as a secondary school teacher at 'the Teachers' College' (Hillside) in Bulawayo and teaching science in rural schools in Zimbabwe, I then moved to South Africa where I was employed as a Science and Geography teacher in a rural school in UMzinyathi district in KZN province. I discovered that the conditions regarding the status of science education in these two countries were more or less the same with reference to infrastructure and resource provision. Further, regardless of the fact that I was teaching the subject having failed to clearly determine the attributions of science teachers in Zimbabwe, I wanted to develop an understanding of the nature of Physical Sciences teacher attributions in the South African context where I was teaching.

Again, there is evidence supporting limited research in rural and township schools (see for example Arnold 2005; Gaddy and Dean 2005; Hlalele 2012; Moletsane 2012). I was, thus, motivated to study teachers in these two contexts and add the urban context for comparison. It is from this background that I was intrinsically motivated to have an in-depth understanding of the teacher attributions to their teaching practice and how that influenced their growth as teachers of Physical Sciences.

Having taught sciences for many years, I embarked on this study with some axiological assumptions that I discuss in the following sub-section.

Axiological Assumptions

Axiology focuses on the ethical issues that need to be considered when planning a research study (Kivunja and Kuyini 2017). It involves defining, evaluating and understanding concepts of right and wrong behaviour relating to the research (Antwi and Kasim 2015). In other words, axiological assumptions address all questions related to research ethics: human values and respect, participants' rights, moral issues, doing good and preventing harm, fairness and minimising risk or harm to participants. Thus, axiological assumptions are the basic values and biases that I brought into my research.

As the major data generation instrument – I generated data through face-to-face interviews, document reviews and lesson observations – my presence was evident in the interpretation and presentation of the data. My epistemological role had some implications for the axiological assumptions in this study. My attributions to these Physical Sciences teachers' attributions to

pedagogies were shaped by my experiences as a science teacher in both Zimbabwe and South Africa. The participants who took part in this study were science teachers in UMzinyathi district where I worked and I had interacted with a few of them during workshops. We would chat during tea breaks on social and work-related issues covering content in the subject and general challenges. I, thus, carried certain biases to my study due to my experience as a teacher and also having interacted with some participants. I should state upfront that in this study I studied these Physical Sciences teachers' in their natural settings but paid particular attention to their attributions to pedagogical practices in their different school contexts.

Notwithstanding my efforts to maintain an open mind during data production, those biases might have influenced my views and perceptions of the generated data and the manner in which I analysed it. I embarked on this study with the perception that these Physical Sciences teachers had complex and different attributions to their pedagogy. Despite the significance of this expectation, I critically interrogated these teachers on their attributions related to Physical Sciences pedagogy. Against this, I explored the values of my participants and analysed them to determine how teacher attributions to their current teaching practice influenced their growth and also their reflections as teachers. Having declared my axiological assumptions in advance, the rationale for the study is presented in the next section.

Rationale for the Study

The rationale for this study is underpinned by three considerations: personal, academic and policy issues. First, at a personal level, as I highlighted above, my teaching experience was in, sciences and my masters research focused on learner attributions. Given that new ways and ideas implemented often emanate from research (Mukeredzi 2009), the study would satisfy this utilitarian significance and, as a result, findings would be of utmost benefit to my practice, responsibilities and professional growth.

Secondly, while some academic work, as highlighted above, has been carried out internationally, regionally, and nationally, such work targeted other aspects of attributions and did not specifically investigate Grade 12 Physical Sciences teacher attributions to their pedagogical practices and how such attributions influenced their growth as professionals. Hence, it is this gap in literature to which this study would contribute. The limited research on this phenomenon apart from creating a gap might also be interpreted to indicate the low regard given to Physical Sciences. By investigating the 'what' and 'how' of urban, township and rural

Physical Sciences teacher attributions to their classroom practices in UMzinyathi district secondary schools, this research would contribute to knowledge in this area.

Concomitant to the above, that teacher attributions to teaching and learning are strongly linked to professional growth has been documented (see for example Borg 2003; Karabenick and Conley 2011; Steyn 2010; Skoumious and Skoumpourdi 2021). Horn and Little (2010) add that when teachers engage in on-going professionally 'growthful' activities, their pedagogical knowledge continues to expand from connecting frameworks for teaching to specific contexts and instances of instructional practice. This study was premised on the notion that not much is known about teacher attributions in general, the Physical Sciences teachers studied in particular, and their influence on their professional growth (Petrie 2013). It, therefore, became vital to learn about their pedagogical attributions from them and how these influence their work.

Third, with regard to policy as highlighted above, Physical Sciences is a critical subject and key to the country's economic growth (Kelder 2007; Ogunniyi 2011; DBE 2017). The participants in this study were Physical Sciences teachers, therefore, questions regarding their pedagogical attributions to Physical Sciences needed to be answered, given that this is a critical subject which contributes to the country's economic development and stimulates leaners' critical thinking and problem solving. Teacher attributions can act as an interface between curriculum and practice (Azis 2015), thus, understanding the Physical Sciences teachers' attributions to their pedagogical practices cannot be overemphasised. Again, as alluded to above, teacher attributions are key to classroom practice and learner achievement as they influence teachers' pedagogic approaches and choice of materials, methods, content and learner activities (Chai, Koh and Tsai 2013; Mukeredzi 2013). It was, therefore, critical that Physical Sciences teacher attributions be understood as they have a strong influence on teacher practice and learner achievement.

Again, with regard to policy, there is limited literature available for policy makers on the nature of Physical Sciences teacher attributions to their pedagogical practices and how such ascriptions influence their growth as teachers of science. The challenges and the pressures that the Physical Sciences teachers endure, particularly in marginalised contexts, and the professional growth encounters that they undergo in these schools needed to be investigated and documented. Teachers in such situations are expected to devise effective and imaginative strategies for handling learners and school communities as they try to interpret and deliver laid-

down curriculum policies and procedures (Mukeredzi 2009). Through collegial interaction around Physical Sciences in relation to their classroom practices, the Physical Sciences teachers can influence policy development, critique and practice. This study, therefore, sought to contribute to teacher education discourses broadly but in particular to the nature of Physical Sciences teacher attributions and their influence on classroom practice. Thus, findings from this study would hopefully inform the discussions and decisions of policy makers, as well as teacher education specialists, professionals, and academics, on issues around Physical Sciences teacher attributions in South African rural, township and urban schools. The next section outlines the statement of the problem and sets out the research questions that guided the study.

Statement of the Problem and Research Questions.

That teacher attributions are critical to classroom practice is well documented (see for example Little and Akin-Little 2011; Petrie 2013; Lyakurwa 2012; Kafyulilo 2010; Ramnarain and Hlatswayo 2018; Mavhunga and Rollnick 2015). However, a literature search did not yield much research on the nature of Physical Sciences teacher attributions to their pedagogical practices in schools in KZN Province. Thus, not much is known specifically about the nature of Grade 12 Physical Sciences teacher attributions and their influence on teacher professional growth in rural, township and urban schools. In addition, there is limited research on teacher professional growth in the sciences compared to other subjects like mathematics (Gaddy and Dean 2005; Moletsane 2012; Arnold 2005). Thus, an in-depth understanding of the nature of Physical Sciences teacher attributions to their practice and the influence of those attributions on the teachers' professional growth needed not only to be understood but also, the study would contribute to the gap in knowledge around the phenomenon.

The study revolved around one key question: *To what do Physical Sciences teachers attribute their pedagogical practices and how do the attributions shape their professional growth?*

This main question was unpacked by addressing two subsidiary questions:

1. What is the nature of Physical Sciences teacher attributions to their pedagogical practices in secondary schools?

2. In what ways do the Physical Sciences teacher attributions shape their professional growth?

Overview of the Theoretical Framework

My study which explored Physical Sciences teachers' attributions to their pedagogical practices in secondary schools and how these attributions shape their professional growth drew on Weiner's (1986) theory of causal attribution, complemented by Bell and Gilbert's (1996) aspects of professional learning. Thus, Weiner's (1986) theoretical framework and Bell and Gilbert's aspects of professional learning complemented and supported one another as the shortcomings of one were addressed by the strengths of the other, thereby enabling a more nuanced understanding and picture of the reality under exploration (Mukeredzi 2013).

An attribution, as alluded to earlier, is a person's perceived reason (or attitude that they display) that they give for a particular event or action (Weiner 1986). It, therefore, refers to the explanations, reasons (or attitudes) that people give (or portray) for their own or other people's actions or behaviour. Weiner (1986) proposes four causes, which are the most general and significant, used to interpret the outcome of an achievement-related event: ability; effort; task difficulty; and luck. Dispositional (internal) attributions include all causes that are internal to the teacher, like attitudes to their work or subject, personality traits which affect their teaching (including classroom management), teaching abilities (Subject Content Knowledge, Pedagogical Content Knowledge and Pedagogical Knowledge) or wishes. On the other hand, situational (external) attributions include all causes that are external to the teacher, like learner attitude towards the subject, learner ability (progressed learners included), resourcing, collegial interactions, social situations or any other such work-related aspects (Weiner 1986) which the teacher cannot control.

The use of Weiner's (1986) theory of causal attribution was effective in revealing the nature of Physical Sciences teacher attributions: whether they were internal or external. However, this theory was unable to help me unpack and understand how the attributions influenced teacher professional growth. I, thus, sought a complementary theory to help understand and explain professional growth.

The complementary theory, Bell and Gilbert's (1996) Aspects of Professional Learning, as highlighted above, was intended to help unpack data and present findings that addressed Research Question Two: understanding and explaining the impetus for professional growth. According to these authors, teacher professional growth is comprised of personal, social and occupational aspects which are inter-related. The combination of Bell and Gilbert's (1996) theory and Weiner's (1986) attribution theory was effective in answering my research

questions by enabling analysing the nature of attribution and the dimension or impetus for professional growth. The next section presents an overview of the methodological approach.

Overview of the methodological approach

The study employed a qualitative approach within the interpretive paradigm and a case study design. The interpretive paradigm assumes that reality is constructed inter-subjectively through the meanings and understandings developed socially and experientially (Cohen, Manion and Morrison 2013). Given that attributions deal with beliefs, feelings and attitudes, this paradigm was considered appropriate. I adopted the qualitative approach in this study because of its holistic nature which strives to record the multiple interpretations of intentions and meanings given to situations, experiences and events (Cohen, Manion and Morrison 2013) by participants. I decided to use this approach to understand the nature of Physical Sciences teachers' pedagogical practices and their influence on professional growth. Yin (2009) states that case study design is a powerful instrument which provides for in-depth investigation of a phenomenon. I used multiple-site case study design which enabled me to capture rich descriptive data on the nature of teacher attributions and their influence on pedagogy. The methodology chapter also discusses population, sample and sampling techniques. Data production processes (two-series interviews, document reviews and lesson observations), as well as data analysis, were discussed illustrating all choices and moves taken in answering such questions as 'what I did?', 'why I did it?', 'how I did it?' and 'with whom I did it?'. Attempts that were undertaken to enhance rigour through the four qualitative aspects of credibility, transferability, auditability and confirmability were also discussed before outlining the ethical considerations.

In the next section I discuss operational definitions of key terms that were used in this study.

Definition of Terms

The operational definitions of key terms provided in this section are intended to show the reader how the concepts and terms are understood in the context of this study and applied by the author.

Attributions refers to the explanations or reasons that teachers give for their or other people's actions, behaviour, feelings, attitudes or beliefs, skills and knowledge to their teaching and learning experiences (Weiner 2005). In other words, in this study these are teacher beliefs,

attitudes, views, understandings and perceptions which form the basis for the teachers' classroom and pedagogical choices, decisions and actions.

Physical Sciences is a subject (learning area) which is taught from Grade 10 to Grade 12 in South Africa (FET Phase). The subject is a combination of Physics and Chemistry. The subject aims to investigate physical and chemical phenomena through scientific inquiry, application of scientific models, theories and laws in order to explain and predict events in the physical environment (DBE 2011) This subject also deals with society's need to understand how the physical environment works in order to benefit from it and responsibly care for it.

Pedagogical practices refers to the teaching approaches used by teachers in classroom practice (Moore-Cox 2017). In this study it refers to the teaching approaches used in both theory and laboratory work – from lesson preparation and planning, lesson delivery, assessment, to lesson reflection in Physical Sciences. A carefully considered pedagogy is essential in enabling students to learn more effectively and can help them develop high-order thinking skills (Fischer et al. 2018; Mukeredzi 2013).

Professional growth refers to broader changes that may take place over a longer period of time as continuation of a teacher's professional development beyond their initial training, qualification and induction (Mitchell's 2013**).** Thus, with this understanding, professional growth in this study is understood as the outcome of multiple specific changes accrued through teacher learning and experience which enable Physical Sciences teachers to renew, review and extend their practice and improve or increase knowledge of the subjects that they teach.

Chapter Summary and Overview of the Thesis

This Chapter presented a background for the study. This was achieved by first outlining the background of the study which provided a synopsis of the history of teacher education in South Africa – both pre- and post-liberation – followed by the policy context of the study. Thereafter, I discussed the state of Physical Sciences teaching and learning in South Africa. The focus and purpose of the study were then outlined. Thereafter, I presented my personal context and motivation for the study. The next section outlined my axiological assumptions where I declared upfront my values and biases as the main data generation instrument and how I interrogated Physical Sciences teacher attributions. I then defined the rationale behind the study. Following this was a statement of the problem where I highlighted the paucity of research on the phenomenon and then set out the key question and sub-research questions. The overviews of theoretical frameworks and methodology were then outlined. The issues of

trustworthiness and ethical considerations were discussed in the last section followed by this summary and a description of the structure and organisation of the thesis.

Chapter Two discusses literature related to this study from international, regional and national contexts. This literature was organized conceptually and guided by research questions addressing the nature of teacher attributions to their pedagogy and the influence of teacher attributions on teacher professional growth.

Chapter Three presents the two theoretical frameworks which guided this study. Weiner's (1986) theory of causal attributions and Bell and Gilbert's (1996) Aspects of Professional Learning. The two theories which guided data generation were lenses for data presentation and analysis. The discussion of theories in this chapter covers historical development, principles or key ideas of the theory as well as the application and critique of these theories.

Chapter Four presents the research design and methodology. It describes and justifies the interpretive paradigm, case study research design, qualitative approach and purposive sampling which was employed for selecting participants. The research setting is followed by an outline of how I gained access to participants. Population and sampling design, as well as the sample, are presented followed by piloting. The processes of data generation through two-series interview, complemented by document reviews and lesson observations are also described and all choices and moves justified. The chapter then outlines the steps followed in data analysis. Finally, aspects of trustworthiness and ethical considerations, as well as the limitations of the study and how they were dealt with to minimize their impact on findings, are discussed.

Chapter Five presents and analyses data addressing Research Question One the nature of Physical Sciences teacher attributions to their pedagogical practices. Weiner's (1986) theory of causal attribution provides the lens in analysing, describing and explaining findings.

Chapter Six presents and discusses data answering Research Question Two on how teacher attributions shape their professional growth. This discussion draws mainly on Bell and Gilbert's (1996) Aspects of Professional Learning to unpack data and explain the findings**.**

Chapter Seven is the final part of this thesis which presents the discussion and synthesis of the study findings. Findings from the study are discussed according to the research questions to illustrate how the questions raised at the start of the research, in this chapter are answered. The chapter then outlines theoretical reflections on the study followed by methodological reflections. Subsequent to this, is a review of the study. This chapter also discusses the

contribution of this study and offers some recommendations drawn from the findings related to policy and practice, as well as recommendations for further research. This is followed by the chapter conclusion.

Having set the scene in this introductory chapter, in the next chapter I present a critical review of relevant literature around teacher attributions and their influence on professional growth.

CHAPTER TWO
REVIEW OF RELEVANT LITERATURE

Introduction

Through an exploration of 16 Physical Sciences teachers drawn from rural, township and urban schools, the study sought to understand the nature of these teachers' attributions to their pedagogical practices and how these attributions shaped their professional growth. Generally, teacher attributions are prevalent across all contexts and cultures and, hence, they have a bearing on teacher professional growth. The previous chapter introduced the study and provided the focus, personal context and motivation, rationale, research questions and background of the study. The introductory chapter also provided overviews of the theoretical and conceptual frameworks, the methodological approach and the axiological assumptions. Further, the chapter provided a summary of the historical background of education in South Africa during and after apartheid, inclusive of teacher education.

This second chapter critically analyses the literature reviewed from books and scholarly journal articles relevant to my study, in particular the nature of teacher attributions and their influence on their pedagogical practices. Most of the empirical studies critically analysed in this chapter were from 2010 to 2021. However, I also consulted a few dated sources from as far back as 1991 because of the pertinent information contained therein. The literature review process was vital for contextualising my study and to enhance understanding of how similar related concepts are defined and understood by other researchers. The process also exposed me to the experts in the field and how they generally engage with research principles, methodologies, and processes related to my study, which enabled me to place my study in perspective, situating it appropriately.

According to Mudavanhu (2017), a literature review in research provides an understanding of the existing information, helps to identify areas of controversy or debates that are relevant to a particular topic, and where future research might best be directed. In this chapter, I illustrate what has been written on my topic, and also discuss those relevant topics that may have been discussed differently, thus contextualising my study and identifying the literature gap which my study will contribute to. In the same vein, Arshed and Danson (2015) point out that the literature review is an evaluative report of studies found in the literature related to a selected area of research. The purpose of this literature review was to critically evaluate previous studies to further justify my research, identifying questions related to my study that had been answered

and those that were outstanding, to ensure that the study was not just a 'replication study' but would serve a clear purpose by contributing to the gap in the existing body of knowledge. Consequently, this offered broad understandings of what has been studied on Physical Sciences teacher attributions to their pedagogical practices.

According to Tanczer (2015), a literature review chapter may be organised in accordance with any of three approaches, namely, a chronological, contextual or conceptual approach. In this chapter I adopted the conceptual approach where I organised the literature review around my main research question: '*To what do Physical Sciences teachers attribute their pedagogical practices and how do the attributions shape their professional growth?*' I adapted my two research questions to key subheadings used in the chapter. Within these sections, literature is discussed conceptually but according to the three contexts – global, regional and national – thereby adopting a 'funnel' approach.

The chapter begins by defining and discussing the concepts around professional growth and its derivatives: profession; professional; and professionalism. It finishes off with professional growth from international, regional, and national understandings. Second, the chapter discusses literature around the nature of Physical Sciences teacher attributions to their pedagogical practices. Third, the chapter examines literature on how attributions shape teacher professional growth. The chapter concludes with a summary that ties the literature review together.

Unpacking Concepts

What is a Profession?

Saks (2012) in the United Kingdom (UK) defines 'profession' as a socially negotiated label based on occupational ideologies, not least in terms of the knowledge and skills involved. The participants in this study were labelled as teachers according to stipulations by the South African Council of Educators (SACE) with whom all teachers must be registered in order to teach in South African schools (SACE 2005). Among these stipulations teachers are required to hold an appropriate teaching qualification. Hence, the Physical Sciences teachers who participated in this study belonged to a teaching profession as they were specialists with knowledge and skills in Physical Sciences holding various teaching qualifications such as National Professional Diploma in Education (NPDE), Advanced Certificate in Teaching (ACT) and Bachelor of Education degree (B.Ed.).

Another perspective from Professional Standards Council (PSC) (2015) of Australia is that a profession is a disciplined group of individuals who adhere to ethical standards. The two views from Saks and the PSC emphasise ideology, skills, knowledge and ethics as key elements of a profession. Given that participants in this study were registered as teachers, and were teaching in South Africa, they were obliged to follow the SACE code of conduct, as well as the rules within their schools. Thus, drawing on the above international definitions, a profession is a disciplined group of individuals bound together by their occupational ideology, knowledge, and skills, and guided by ethical procedures. Participants in this study possess these qualities.

Regionally, Yusuf, Afolabi and Oyetayo (2014) from Nigeria view a profession as an occupation or vocation that requires special skills, knowledge of some department of learning and qualification, especially one with high social status. Knowledge and skills highlighted here are also raised by Saks (2012) in the UK and PSC (2015) of Australia. While Yusuf, Afolabi and Oyetayo (2014) agree with Saks and PSC in terms of occupation, skills and knowledge, the latter bring up the issue of social status. Physical Sciences teachers in the current study were viewed as belonging to a profession given their possession of knowledge and skills and their performance of a social role – teaching.

Still in Nigeria, Dada and Fadokun (2010) assert that a profession entails an occupation which is dependent upon specialised intellectual study and training for the provision of skilled service to other members of society, government and non-governmental agencies, for a definite fee or salary. While Dada and Fadokun agree with Yusuf, Afolabi and Oyetayo in terms of occupation, skills, knowledge, departmental affiliation and qualification, Dada and Fadokun add the issue of remuneration. As alluded to above, the teachers in this study were professionals as they had engaged in tertiary studies and training to obtain a qualification and were offering a social service – teaching Physical Sciences to FET Grade 12 learners. Therefore, within the region, a profession is understood as an occupation for people who have knowledge, skills and a certain qualification obtained through training, and who offer a social service to society for an agreed remuneration.

Nationally, Adendorff et al. (2002) define profession as an occupation that performs a vital social function or service requiring a significant degree of skill and expertise. Adendorff et al.'s definition relates to the authors above in terms of occupational skills and expertise, which relates to training. Hence, teaching in this study, is regarded as a profession given that Physical Sciences teachers perform a crucial social function which requires skill and expertise gained

through training and are also employed and remunerated by the DBE. From the definitions above, a profession is, therefore, understood in this study to be comprised of a group of people belonging to an occupation, performing a social function for which they receive a salary, possessing skills and knowledge from training and who are bound by ethical procedures in their service.

What is a Professional?

From the international context, Brown et al. (2017) in the United States of America (USA) view a professional as a member of a profession. They further state that professionals are ruled by codes of ethics and profess commitment to competence, morality and integrity, altruism and the promotion of the public good within their expert domain. Simply put, a professional from this definition is a member of a profession with a good standing and unquestionable character in the eyes of the public. The teachers who participated in the current study were guided by the SACE code of conduct and had to adhere to the rules, policies and regulations as stipulated by this national professional body.

Still in the international context, Balthazard (2015) in Canada, in support of the above views, conceives a professional as one who prioritises "good and quality" work ahead of economic gain (salary). Thus, according to Balthazard, a professional is an individual committed to their work quality and integrity: they maintain a high standard of performance and efficiency, as well as other attributes of a professional which leads to professionalism. The Canadian and USA definitions highlight competence, altruism, morality, integrity, commitment, efficiency and high-quality work.

Regionally, Fareo (2015) in Nigeria states that a professional is a well-qualified person with good professional competence who aims for effectiveness. In the Nigerian context the government makes provision for the professional growth of teachers through periodic in-service education. Therefore, in this study, a professional is viewed as a teacher who is keen to grow professionally and change in order to improve knowledge in Physical Sciences pedagogy.

Nationally, literature surveyed by De Wet (2016) shows that professional work involves a highly complex set of skills, intellectual functioning and knowledge that is not easily acquired and not widely held. Teachers' work is generally viewed as complex in nature (Bertram 2014), demanding intellect and knowledge that is acquired through rigorous training. In this study, the term 'professional' relates to members of a profession who demonstrate confidence, expert knowledge, and skills during instructional practice, who are governed by codes of ethics, who

profess commitment to their work, have competence and efficiency, maintain morality and integrity and altruism and work in collaboration with one another.

What is Professionalism?

In Spain, Vivanco and Delgado-Bolton (2015) defined professionalism as a status that is reached, maintained, and improved through the continuous effort and perseverance of those who practice the human principles and values that constitute it. Thus, according to this definition the Physical Sciences teachers in the current study may be regarded as striving towards professionalism through possession of appropriate attributes and values, engaging and adopting acceptable principles in their practice throughout their professional lives. Vivanco and Delgado-Bolton further state that technical expertise, ethics and skills and communications are all vital components of professionalism. The definition by Vivanco and Delgado-Bolton includes seven key elements: status that is maintained, continuous effort, perseverance, principles, ethics and skills, communication and values. Consequently, the Physical Sciences teachers in this study ought to display professionalism through their teaching expertise, ethical behaviour and good communication skills.

Regionally, Nkhoma (2010:73) defines professionalism as*:* "the conduct of qualified people who share responsibilities for rendering a service; for engaging in continued study; and for maintaining high standards of achievement and practice within the principles, structure and content of a body of knowledge." Vivanco and Delgado-Bolton and Nkhoma concur on ethics, maintaining high standards, continued study, communication, expertise, principles, knowledge, and skills as certain aspects of professionalism. However, Nkhoma extended the definition by adding structure and possession of content knowledge. Given that the participants in this study were all qualified Physical Sciences teachers who were rendering a service (teaching) to society and maintaining acceptable standards of practice within the stipulated principles and policies, one could argue that they fulfilled the attributes of professionalism.

In South Africa, professionalism is a pedagogical term centred on the internal quality of teaching as a profession, with its relative control in making autonomous decisions over teaching practice (SACE 2005). Nationally, Julie, Bimray and Jooste (2019) also defined professionalism as the conduct, qualities, vision, mission, values and goals that characterise a profession, which describes behaviours that are expected within the profession's members. The South African definition highlights quality, values and conduct which is consistent with international and regional definitions but extends professionalism to include vision, mission

and goals. In the context of this study, professionalism could be seen as a powerful tool which guided teachers in fulfilling their roles to the best of their ability.

Literature reviewed by de Klerk (2014) further asserts that professionalism is characterised by moral attributes that teachers strive to attain, based on excellence, teamwork, collaboration, professional development and trust. Further, Adendorff et al. (2002) in surveyed literature state that professionalism requires the teacher to be responsible for organising and maintaining an effective, safe environment for learners and learning, as well as being a 'knowledge worker', and as someone likely to have a considerable influence on learners' values. The definitions above by de Klerk (2014) and Adendorff et al. (2002) highlight moral attributes, excellence, trust and being a knowledge worker as some of the qualities of professionalism. However, De Klerk also includes teamwork and collaboration as other vital attributes.

For the purposes of this study, professionalism encompasses ethical and moral behaviour, honesty, empathy, accountability, commitment, devotion and conscientiousness, a desire for life-long learning and enquiry, relational dimensions, interdependence, agency and resourcefulness.

The Concept of Professional Growth

Villegas-Reimers (2003), in the international context, defined professional growth as development of a person in his or her professional roles. It includes formal experiences (such as attending professional meetings, workshops and mentoring) and informal experiences that take place through reading professional publications and watching television documentaries related to an academic discipline. This resonates with Mitchell's (2013) conception where professional growth refers to broader changes that may take place over a longer period of time as continuation of a teacher's professional development beyond their initial training, qualification and induction. Thus, professional growth is the outcome of multiple specific changes accrued through teacher learning and experience which enable teachers to renew, review and extend their practice and improve or increase knowledge of the subjects that they teach. Middlewood, Parker and Beere (2013) assert that professional growth is an ongoing process of reflection on one's practices and learning, therefore, leading to development of skills and knowledge. The acquisition of new skills and knowledge may result in teacher change which could manifest in the improvement and implementation of some new or different practices. Villegas-Reimers, Mitchell and Middlewood, Parker and Beere's definitions have common goals of increasing teachers' knowledge, positively transforming classroom practice

and enhancing students' performance through on-the-job-learning. Given this overall overlap in the goals of professional growth and professional development to enhance classroom practice and students' achievements, in this study, particularly in this chapter, the concepts will be used interchangeably.

Regionally, Sithole (2020) indicates that professional growth, when designed well, is typically interactive, sustained and customised to teacher needs which encourages teachers to take responsibility for their own learning and to practise what they are learning in their own teaching contexts. Sithole emphasises interaction which is on-going and teachers taking responsibility for their learning and application of what is learnt in their classrooms.

Nationally, Bertram (2014) explains that professional growth may take place in a range of different places and spaces, both formal, non-formal and informal and not only as a result of formal professional development activities. Bertram's definition includes formal, non-formal and informal growth and development activities, while Sithole's definition focuses on teachers' interaction, on-going process, teachers taking responsibility and initiative for their learning needs and implementing the learning in their classrooms.

Drawing on the above authors, professional growth in this study is understood as those experiences that are sustained (on-going), job-embedded, that occur through interaction and collaboration, where teachers assume responsibility to improve their knowledge to enhance learners' performance and outcomes. Having defined concepts around professional growth and its derivatives, next I critically evaluate literature on the nature of teacher attributions drawing on international, regional, and national studies.

Nature of Teacher Attributions to their Pedagogical Practices

In the international context, academic work (see Johansen, Little and Akin-Little 2011; Kulinna 2009; Petrie 2013; Riley and Ungerleider 2012; Adams 2012; Vail 2011) has been conducted on the nature of teacher attributions to their pedagogy. Regrettably, not much has focused on the nature of Physical Sciences teacher attributions to their pedagogical practices specifically. The following section reviews literature in the international context.

Johansen, Little and Akin-Little (2011) in New Zealand studied teacher attributions and perceptions of behaviour and classroom management. The study was located in an interpretive paradigm which utilised both quantitative and qualitative approaches. Participants were 42 teachers from primary schools in the Hawke's Bay area. Furthermore, data were generated

through questionnaires using a 5-point Likert scale for a number of questions, that is, questions requiring YES or NO answers and multiple-choice questions.

While Johansen et al.'s (2011) study differed from the current study in terms of data generation techniques, sample size and its focus on Primary teachers, it is related due to its research paradigm and approach. Their findings indicated that teachers tend to attribute the cause of school behaviour problems primarily to external factors such as home circumstances and parenting. This view is in line with Paine's (2013) study which also indicates that most children who come from poor communities have shattered backgrounds and are characterised by families without meaningful employment, single parent households and an increase in the number of children cared for by grandparents (external attribution). If teachers perceive that the cause is beyond their classroom influence and practice, then they are not likely to look for ways in which they can positively change that behaviour and enhance learning (Johansen et al. 2011). However, if teachers perceive that a learner is able to control his/her behaviour and learn when behavioural problems occur, they will presume that the learner has the capacity to change behaviour in some way and benefit from their teaching practice. Johansen et al.'s (2011) study generally shows that teachers attributed their pedagogical practices to external factors. The findings from Johansen et al.'s study are consistent with theory (Weiner 19865) which asserts that external attributions are stable and uncontrollable and, consequently, how teachers perceive behaviour determines how they will respond or react to it. Thus, how teachers respond to or react to a learner's behaviour depends on their understanding and interpretation (attributions) of that behaviour. This study, therefore, wanted to establish whether the Physical Sciences teachers' attributions (understandings and interpretations) related to their pedagogical practices or classroom management behaviours influenced their classroom practice.

Closely related to Johansen et al. (2011), Kulinna (2009) in the USA studied teacher attributions and strategies for addressing student misbehaviour (external attribution). Given that this current study focuses on teacher attributions to their pedagogical practices, it was important to rope in learner behaviour since it is an issue in classroom management. The study was interpretive in nature, employing narrative accounts and semi-structured interviews involving high school teachers drawn from different learning areas. This study relates to my current study in that it focuses on teacher attributions to their pedagogical practices (managing student behaviour) and it also adopts Weiner's (2005) attribution theory. The study (Kulinna) found that teachers tend to accept responsibility for the academic success of their students but fail to do the same for students' academic failure. This may affect the pedagogical support that

the teacher offers to the different students particularly those showing signs of failure. Drawing from Kulinna's (2009) study, these high school teachers were less willing to accept responsibility for their role in student behaviour as they probably believed older students should be held responsible for their actions. This inherently implies that students about whom negative perceptions are held may not be provided the same pedagogical opportunities for performance improvement in academic work. As such teacher attributions would influence their pedagogical practices. The USA study shows that teachers attributed their classroom practice around classroom management to learner behaviour (external attribution). Accepting responsibility for learner success but failing to do so for learner failure, as found in the USA study, is an internal attribution which Weiner (2005) calls 'self-centred bias'. It was, thus, the intention of this study to determine the nature of these teacher attributions to their pedagogical practices.

Still in the international context, Petrie (2013) in the UK studied teacher attribution style, self-efficacy and beliefs about differentiation. The study had a big sample which comprised 84 student teachers from Roehampton University. This was a quantitative study where a 20-item questionnaire was used to generate data. The study discovered that teachers with internal attribution styles put more effort into their pedagogies in teaching low performing learners. In contrast, teachers with external attribution styles were more likely to reject these learners and cease their attempts to help them. As in the current study, Petrie (2013) investigated the 'what and how' behind student teachers' attributions to their pedagogical practices. The processes to establish the answers to these questions pointed me to areas which could be examined in my study, such as whether teachers put a lot of effort in supporting low performing learners or ceased their attempts to help them on the realisation of their low performance. Concomitantly, Hashweh (1996), in the Asia Pacific Forum, who studied Palestinian teachers to identify the relationship between teacher attributions and classroom pedagogy found that differences in teacher attributions influenced classroom teaching and professional growth. Such attributions influence the teachers' desire to learn given that it is only when teachers feel motivated to learn something that they will be open to learning (Guskey 2002). Roehrig and Kruse (2015), from a study aimed at understanding the impact of a reform-based Natural Sciences curriculum on teachers' classroom practices and the effects of teacher beliefs and knowledge of their implementation of the curriculum, concluded that teaching attributions have a significant influence on classroom practices. Petrie's (2013) study shows that teachers attributed their pedagogy to both internal and external factors.

In Canada, Riley and Ungerleider (2012) studied how teachers' attributions, expectations and stereotypes influence the learning opportunities of Aboriginal students. This was a case study within a qualitative approach. The study had 21 teachers all drawn from an urban area in Western Canada and data were generated through individual face-to-face interviews. Findings indicated that teachers were more likely to base decisions about learner learning on limited social and behavioural cues such as who the students were or the socio-economic status of their family (external attribution) rather than on a rational, systematic basis. The current study also sought to find out the basis for the teachers' decisions in view of the learners' social and behavioural cues. Such teachers often make assessment decisions based on misattributions rather than on the student's actual ability. Contrary to the above findings, Baker and Jones (2005) assert that there is a relationship between low socio-economic status and poor performance in sciences. Barker and Jones' view is supported by Saiduddin (2013) who highlights that factors such as unstable homes, drug abuse and teenage pregnancy contribute to poor performance in sciences among learners. All these issues influence teacher attributions and eventually their professional growth. Further, teachers who attribute a student's lack of understanding or poor academic performance to the child's low abilities, for example, are more likely to respond to the student with pity rather than anger (Georgiou, Christou and Panaoura 2002). From such conceptions these teachers may, thus, develop their own "knowledge-in-practice" which is teacher knowledge that is constructed through their everyday teaching practices and experiences (Kelly 2006; Mukeredzi 2013) to assist that learner. This kind of knowledge-in-practice that the teachers develop through their teaching experiences will contribute to their professional growth.

While Riley and Ungerleider's study was conducted in an urban area only, the current study added rural and township schools to enhance the comparative aspect. As Riley and Ungerleider adopted Weiner's attribution theory, my study was able to draw lessons from and allow for comparisons of the nature of teacher attributions to their pedagogical practice.

Closely related to Riley and Ungerleider's study, Winter and Butzon (2009) studied teacher attributions and school reform in South Carolina (USA) focusing on how efforts to improve school performance are impacted by teacher attributions about learners' success or failure. This USA study was a qualitative case study which was conducted in rural and sub-urban areas. The study used interviews for data generation. The results indicated that teachers attributed school performance to learners' family background citing poverty, especially in schools where poor children constituted a high percentage of the enrolment. Learner performance (external

attribution) is not the focus of this study but is a product of teacher pedagogical practices in a way. Consequently, this study is related to the current study, which seeks to explore teacher attributions to their pedagogical practices and also looks to establish whether teachers in my study attributed learner performance to family background.

Winter and Butzon argued against this external attribution, citing the USA former president's speech:

> "*From the moment students enter a school, the most important factor in their success is not the colour of their skin or the income of their parents, it's the person standing at the front of the classroom*".
>
> (Former President Obama 2009).

Attributing the problem to the learners is an external attribution, unlikely to change as it is out of the teachers' control and a barrier to classroom practice. As such, it would be unlikely that the teachers would modify their pedagogical practices. If the teacher attributes the problem to the learner (external and stable factor) they are less likely to put more effort into helping the learner (Weiner 2005) which, consequently, affects their pedagogical practices. This study drew from Weiner's attribution theory. Given that Weiner's theory was adopted in my current study, this provided me with guidance on the application of theory regarding the nature of teacher attributions to their pedagogy.

In China, Adams (2012) explored teacher attributions and mathematics achievement among rural primary schools. The study was quantitative in nature with a sample size of 1000 primary school teachers where questionnaires were used to generate data. Results indicated that teachers attributed learner achievement to their own lack of qualifications (internal and controllable attributions), the shortage of instructional materials and poor conditions of school facilities (external and uncontrollable attributions). The study further cited Gansu, a rural area in China where teachers sometimes work in classrooms without electricity and with poor lighting. In addition, primary school classrooms often did not meet safety standards. Several classrooms could not be used in bad weather. Classrooms did not have enough desks and chairs for all students. Teachers strictly rationed chalk, pencils and paper to make the very limited supplies last until the end of the school year. All these teacher pedagogical practices were attributed to the problems and limitations that the teachers faced in their schools. The participants in Adams study were Mathematics teachers in rural primary schools, whereas participants in this study were Physical Sciences teachers from rural, urban and township schools. Adams' focus on rural

areas gave me the avenue to make comparisons between these with findings from rural context in my study regarding the nature of teacher attributions. Adams' study also shows that teachers attributed their pedagogical practices to both internal and external factors. All these factors combined in Adams' study provided an important foundation and pointers for the current study, as well as aspects to anticipate in my study. Furthermore, while the study was focusing on Physical Sciences, literature on primary school science teachers was pertinent as it provided pointers that would be looked out for in this study.

In California, USA, Vail (2011) investigated teacher perceptions (attributions) of professional learning experiences and implications for teaching practice. The aim was to understand the process by which teachers change their practices, following participation in the professional growth experiences of six Physical Sciences teachers. This USA study was a qualitative case study which was conducted in rural and sub-urban areas. A model of teacher-change by Guskey (2002) and a model of professional development skills with hypothetical development trajectories by Dall'Alba and Sandberg (2006) were the conceptual frameworks adopted in Vail's (2011) study, which adopted a qualitative case study design. Just like in my study, the study used interviews, document reviews and classroom observations for data generation. The participants in Vail's study were Physical Sciences teachers just like in the current study, the only difference being the number of participants. Moreover, similar to the current study, Vail's study used the three data generation instruments. These similarities provided a healthy foundation as I was able to draw lessons from and apply them in my current study. The results indicated that teacher perceptions play a major role in pedagogical practices given that perceptions influence teacher choices of pedagogies, materials and learner activities (Mukeredzi 2013). The view is shared by OECD (2009) who indicate that teachers' ascriptions, beliefs, attitudes and philosophies are important for understanding and improving educational practices and processes. In other words, they are closely linked to teachers' strategies for discharging classroom work in their daily professional pedagogies and they shape students' learning and influence their motivation and achievement. Generally, Vail (2011) shows that teachers attributed their pedagogy to both internal and external factors. It was, thus, the intention of this study to determine the nature of these teacher attributions to their pedagogical practices. This formed an important grounding for my study, to determine whether the Physical Sciences teachers, in their stories, demonstrated whether or not perceptions influenced their classroom practices.

Still in the international context, in the USA, Nixon, Campbell and Luft (2016) investigated the effects of subject-area degree and classroom experience on new chemistry teachers' subject content knowledge (SCK). This qualitative study explores the effects of holding a degree in the subject area one teaches, as well as classroom teaching experience, on teachers' SCK for two chemistry topics: conservation of mass and chemical equilibrium. The study had a sample size of six participants, all teaching chemistry. Data were generated through semi-structured interviews and lesson observations.

Findings from this study show that teachers with degrees in a subject had a better SCK compared to those without degrees and, consequently, attributed their pedagogical practices to SCK (internal attribution). The above finding was in line with Kind (2014) who also found that science teachers with degrees in a subject had a high SCK and had better performing learners. Other studies, however, found that learners of teachers with science degrees performed no better than learners of teachers without science degrees (Diamond, Maerten-Rivera, Rohrer and Lee 2013). Drawing from Weiner (2005), teachers with internal attribution styles are likely to change and professionally grow, since the factors are unstable and controllable. The primary finding of studies that have used direct measures of teachers' SCK is that science teachers overall have inadequate SCK and research has also found that teachers hold misconceptions similar to those observed in learners (Kind 2014). Bertram, Mthiyane and Mukeredzi (2013) concur that lack of SCK among South African teachers is prevalent. Whether teachers in the current study also attributed their pedagogical practices to SCK was not known and needed to be established but generally the findings provided a health ground to anchor my study.

Other findings from Nixon, Campbell and Luft's (2016) study indicate that teachers attribute their pedagogical practices to teaching experience (internal attribution). Chan and Yung (2015) assert that classroom experience leads to the development of science teachers' PCK. Friedrichsen et al. (2009), in a related study, compared the knowledge of participants with and without classroom experience and concluded that participants with classroom experience had more integrated pedagogical knowledge than those without classroom experience, although they did not have notably different PCK. This study provides evidence that teacher pedagogical practices are attributed to teacher qualifications in the subject area and classroom teaching experience (both internal and controllable attributions).

International literature reviewed above focused on the nature of teacher attributions to their pedagogical practices. In the six studies above, teachers teaching in different primary and

secondary school phases were explored. The interview and questionnaires were the popular data generation instruments. Generally, all the studies reviewed used more than one tool to generate data. Methodologically the interpretive paradigm, qualitative and quantitative research approaches were adopted in these studies. All studies – except the study by Vail (2011) – adopted Weiner's attribution theory and a conceptual framework, as is the case in my study.

What also generally emerged in all the international studies evaluated was that teachers attributed their pedagogy to both internal and external factors. While the studies reviewed above researched teacher attributions, only one studied Physical Sciences teacher attributions which further justifies a need for my study. The next section reviews studies on the nature of teacher attributions from the regional context.

Regional studies on the nature of teacher attributions were conducted by Lyakurwa (2012), Kafyulilo (2010), Akiri and Ugborugbo (2009) and Wesonga and Aurah (2019). These are discussed below.

Lyakurwa (2012) studied Teachers' Causal Attributions for Academic Underachievement in Public Secondary Schools in Tanzania. Seventy teachers, who were randomly sampled from seven public secondary schools, participated in the study. It was a case study with a quantitative approach which also adopted Weiner's causal attribution theory. Data were generated through face-to face interviews and questionnaires using a 5-point Likert Scale. Data were analysed through the Statistical Package for Social Sciences (SPSS), version 15. Lyakurwa's study intended to investigate how teachers would explain massive failure in Tanzania, whether internalising or externalising the attributions. The study found that teachers attributed students' failure to factors external to them such as issues to be solved by the government, students and parents. The study concluded that teachers denied responsibility for causing students' massive failure: instead, the relevant ministry and the students themselves were the root cause. While failure rate cannot be blamed entirely on the teachers, studies investigating the relationship between teacher attributions and their practice found that they are consistent with classroom practice (Borg 2003; Guskey 2009). These findings are consistent with Weiner's (2005) attribution theory which asserts that human beings have a tendency to explain success as a product of their personal factors (internal attribution), while they associate failure with situational factors (external attribution). The study further pointed out that the government on the other hand attributed academic underachievement to factors like incompetence among teachers, shortage of laboratories for science subjects, libraries, teaching and learning materials

and laziness among teachers, to the extent that some teachers had once been caned by the district commissioner in Kagera region just because of being considered irresponsible (Lyakurwa 2012). While teachers cannot entirely be blamed for student performance, often teachers have a part to play in the success or failure of their learners due to their passion or lack of it. Effective teachers have a passion for their subject, enthusiasm for teaching, high expectations for their students, offer mentorship through modelling and often "go above and beyond" for the students (Mukeredzi in press). Lyakurwa's (2012) study is different from the current study in that it focused on teacher attributions related to learner academic achievement whereas the current study focuses on Physical Sciences teacher attributions to their pedagogical practices. However, the two studies are grounded on Weiner's causal attribution theory and data were generated through face-to face interviews. These similarities would provide lessons and comparisons, as well as guide the application of theory to my findings.

Akiri and Ugborugbo (2009) in Nigeria studied the relationship between students' performance and teachers' effectiveness in teaching. The study was descriptive in nature and involved 979 teachers drawn from 72 out of the total of 361 public secondary schools in the State by stratified random sampling technique. Adopting Weiner's (2005) causal attribution theory, the study also used two questionnaires and a rating scale and document reviews to generate data. The results showed that effective teachers produced better performing students. Moreover, teachers attributed their pedagogical practices to their general attitude to work and poor teaching habits (both internal attributions) which in turn were attributed to poor motivation. The study also revealed that effective teaching was attributed to availability of resources, general conditions of infrastructure, as well as instructional materials (external attributions) in public secondary schools in Nigeria which, however, were regarded as poor. The current study also examined Physical Sciences teacher attributions related to resource availability, whether or not under-resourcing in any way contributed to their attributions.

Findings from Akiri and Ugborugbo (2009) are in line with Kriek and Grayson (2009) who assert that the national pass rate in science learning (especially Physical Sciences and Mathematics) in South Africa is declining. Some of the factors that contribute to the decrease in the pass rate include shortage of resources (external attribution) and the educators' negative attitude, lack of punctuality, poor interpretation and delivery of the curriculum and gaps in content knowledge (all internal attributions). According to Gough (2009), these factors have a bearing on teacher professional growth. Where there is inadequate teacher content knowledge and lack of preparation for classroom engagements, limited conceptualisation of curriculum

and policies, there is likely to be poor teaching in the classroom and in schools. This study also examined whether the teachers attributed their pedagogical practices to gaps in Physical Sciences. Findings from the above Nigerian study showed that teachers attribute their classroom practice to both internal and external factors.

Akiri and Ugborugbo's (2009) study did not focus specifically on Physical Sciences but was grounded on Weiner's causal attribution theory, as is the case with the current study. This similarity enabled me to compare the nature of teacher attributions from other contexts.

Still in the regional context, Kafyulilo (2010) explored 29 pre-service science and mathematics teacher attributions at Dares Salaam University College of Education (DUCE) on competencies for integrating technology pedagogy and content in teaching. The study adopted Koehler and Mishra's (2009) conceptual framework which focuses on the development of teachers' knowledge of integrating technology, pedagogy and content. The study employed an action-based research design with a qualitative approach. Four kinds of data generation instruments were used in the study: a student questionnaire, a researcher log book, an instructor interview and an observation checklist.

Findings revealed that preservice teachers attributed their classroom practice to technological pedagogical content knowledge (external attribution). Through the use of technology, teachers were able to engage in hands-on activities such as microteaching, lesson preparation and planning. Technology also gave them the opportunity to share their ideas with their peers. This study, from the data tried to determine whether the Physical Sciences attributed their pedagogical practices to technological artefacts or other resources. Sharing ideas (internal attribution) with peers, as alluded to above, enhances professional growth as observed by Topolinski (2014) who states that teachers who engage in cooperative learning with others, make changes in their classroom practice and knowledge. In support of the above findings, Mumhure (2017) asserts that teachers experience professional growth through interaction. This is consistent with Mukeredzi (2009) who argues that teachers experience professional development through interaction in multiple domains of formality and experience. In addition, Kafyulilo's (2010) findings are consistent with Barasua, Nwanekezi and Chetta (2018) who report that students exposed to collaborative learning strategy have improved academic achievement scores than those in individualistic strategy. Findings from the above Tanzanian study showed that teachers attribute their pedagogical practices to both internal and external attributions.

These findings from Kafyulilo' study were pointers to the current study where I also had to determine the nature of teacher attributions in relation to their teaching strategies. The use of interviews and observations directed me to some of the issues to be aware of during my own data generation.

In Kenya, Wesonga and Aurah (2019) investigated the influence of teachers' instructional strategies and students' learning styles on academic achievement in Physics among Kenyan high school students. Located in a quantitative approach, a quasi–experimental pre-test post–test non-equivalent control group design was employed to investigate how three teachers' instructional strategies (guided inquiry, cooperative learning and direct instruction) and three learning styles (visual, auditory and kinaesthetic) influence academic achievement in Physics practical work. The target population was all Form Three Physics teachers in rural Navakholo area. A sample size of five hundred and nineteen (519) Form Three Physics teachers was selected through multistage sampling procedures (purposive sampling, proportionate stratified random sampling and simple random sampling). Findings revealed that teachers attributed their lesson delivery (instructional strategy) to enhance learner achievement to three approaches: guided inquiry, cooperative learning and direct instruction. The findings are supported by Akinbobola (2015) who emphasises that teachers should use various teaching techniques in order to make teaching and learning effective, thereby enhancing learners' academic achievement. The findings further show that instructional strategies as attributed above are a significant determinant of students' academic achievement and process skills acquisition in science, specifically in Physics. The selection of proper instructional strategy in a science lesson ensures the achievement of the stated instructional objective effectively. Instructional strategies are used in the presentation of the lesson to help the students learn by ensuring the smooth delivery of the content. Teaching strategies highlighted in this study are internal attributions which are unstable and controllable. The teacher can manipulate them which influences their pedagogical practices.

This study relates to my study in that the participants were Physical Sciences teachers and the focus was on pedagogical practices. Regardless of the research study approach (quantitative) adopted by Wesonga and Aurah (2019), their findings guided me and directed me to determine what the Physical Sciences teachers attributed their pedagogy to and whether the type of the lesson to be delivered was a factor. Moreover, the sample size in Wesonga and Aurah was large (519), probably because it was located in a quantitative approach which deals with large numbers (Cohen, Manion and Morrison 2011), compared to my current study which was

located in the qualitative approach with a small sample size of 16 participants. The Kenyan study's participants were drawn from a rural context only whereas in my study I added urban and township contexts. This Kenyan study provided me some space for comparison.

From the above critical analysis of regional studies, all were conducted with teachers in secondary schools. Some were grounded in the qualitative research approach while others adopted both qualitative and quantitative approaches and interviews were generally the data generation instrument of choice. The regional studies mostly used one theoretical framework. Just as was reported in international studies, findings indicated that teachers attributed their pedagogical practices to both internal and external attributions. As was seen in the international studies, the regional research evaluated showed that teacher attributions have a bearing on teacher classroom practices. While the targeted sample in these studies included secondary school teachers, none of the studies explored Physical Sciences teacher attributions to their pedagogical practices. My study will, therefore, contribute to that gap.

In the national arena, studies on the nature of teacher attributions to their pedagogy were conducted by Ramnarain and Hlatswayo (2018), Gudyanga and Jita (2019), Mavhunga and Rollnick (2015) and Motloung, Mavuru and McNaught (2021). These are discussed below.

Ramnarain and Hlatswayo (2018) explored teacher beliefs and attitudes about inquiry-based learning (IBL) in a rural school district in Mpumalanga Province of South Africa. The participants were 18 Grade 10 Physical Sciences teachers. The research adopted a mixed methods design. In the first phase of the research, quantitative data were generated by distributing a validated questionnaire to Physical Sciences teachers in an education circuit. The next phase of the research involving teacher interviews, provided a more in-depth explanation of some of the findings, which emerged from the questionnaire.

Findings from Ramnarain and Hlatswayo's (2018) study show that teachers from the rural district attributed their pedagogy to inquiry-based learning (IBL) and had a positive attitude towards it in the teaching and learning of Physical Sciences. Drawing from Weiner's (2005) attribution theory such a pedagogical approach is embedded with the teacher and, hence, it is an unstable internal attribution which is controllable and can change over time. The study further showed that IBL could address issues such as learner motivation and could support learners in understanding abstract science concepts. Findings in Ramnarain and Hlatswayo's (2018) study further showed that despite positive beliefs towards IBL, teachers were less inclined to enact it in their lessons. Teachers claimed that the implementation of IBL was

fraught with difficulty, such as availability of laboratory facilities, teaching materials, time to complete the curriculum and large classes (all external attributions), which created tension in their willingness to implement it. These findings are consistent with Weiner's attribution theory which asserts that external attributions are stable and uncontrollable, consequently teachers who attribute their practice to external factors are not willing to change.

While Ramnarain and Hlatswayo's (2018) study drew participants from the rural context only, the current study added urban and township contexts for comparison. One major similarity between Ramnarain and Hlatswayo's study with the current study is the nature of their participants: in both studies participants were Physical Sciences teachers in the FET phase. It was, therefore, vital in the current study to establish whether the Physical Sciences teachers in the sample had the same type of attributions to their pedagogical practices.

Parallel to Ramnarain and Hlatswayo's (2018) study, Gudyanga and Jita (2019) studied teachers' implementation of laboratory practicals in the Free State Province of South Africa. Specifically, the study focused on Physical Sciences teachers' perceptions and experiences regarding the prescribed laboratory practicals. Complexity theory (Mason 2008) framed their study. Participants were three Grade 11 Physical Sciences teachers drawn from three contexts: urban, township and rural schools. The study was located within a qualitative approach. Data were generated through document reviews of curriculum documents and laboratory instruction activities, complemented by semi-structured interviews with three teachers from different schools. Content analysis reduced the data into codes, categories and themes.

Findings from Gudyanga and Jita's (2019) study showed that teachers were implementing the prescribed practicals and they knew exactly which practicals to conduct with the learners. However, the challenge was on shortage of resources (external attribution). The study further discovered that Inquiry-based learning (IBL) approaches were not undisputed in science practical and laboratory activities but resources were the major attributing factor. Contrary to the above findings, Settlage (2007) argues that the IBL approach does not provide learners with the required scaffolding for learning specific concepts, nor can it adequately enhance the process of science learning. Critics of IBL advocate for teacher-centred expository instruction in high school science, especially for practical experiments (Kirschner et al. 2006).

Gudyanga and Jita's (2019) findings were closely related to Ramnarain and Hlatswayo's (2018). In both studies the challenges identified included the absence of models (external attribution) for teachers on what inquiry-based practical classes should be like, and inadequate

professional development activities (external attribution) that equipped teachers with skills on how to teach with inquiry approaches whilst under time constraints. In addition, both studies cited poor resource provision, poor teaching materials, limited time for curriculum coverage, and large classes (all external attributions) as militating against the enactment of IBL in Physical Sciences classrooms. Drawing on Gudyanga and Jita's (2019) study, my study also sought to determine teacher attributions to their pedagogy as they related to resources and large classes among others.

Gudyanga and Jita's (2019) study was closely related to the current study in many aspects. Firstly, both sets of participants were Physical Sciences teachers at FET phase, the only difference being that Gudyanga and Jita's participants were teaching Grade 11 whereas participants in the current study were teaching Grade 12. However, notwithstanding the difference, I was able to have general view of the nature of Physical Sciences teacher attributions to their pedagogy. Further to the above, despite the differences in the sample size, Gudyanga and Jita's study and the current study drew their participants from three contexts (rural, urban and township). Gudyanga and Jita's study laid a foundation for my study on what to anticipate from these contexts and how to generate, analyse and synthesise data from three contexts. In addition, the two instruments used for data generation (structured interviews and document reviews) were similar, which provided me with more guidance and lessons to draw from. Both Gudyanga and Jita's (2019) and Ramnarain and Hlatswayo's (2018) findings showed that teachers attributed their pedagogy to external factors which are uncontrollable.

Still in the local context, Mavhunga and Rollnick (2015) explored science teacher beliefs related to topic specific pedagogical content knowledge (PCK). The study, with a sample size of 16 participants employed mixed-methods research, a method that presents a pragmatist paradigm embodied in the use of plural research methodologies which frequently results in more holistic research (Johnson and Onwuegbuzie 2004). The participants were pre-service teachers teaching chemistry (a component of Physical Sciences) in their fourth year of university study. A larger proportion of these participants were drawn from disadvantaged communities particularly in deep rural communities. Data were generated through observation.

Findings from the study indicated that teachers who believe that their main role is to provide information in a science classroom practice teacher-centred approaches (internal attribution) and are considered to have traditional and instructional beliefs, while those predominantly practicing learner-centred enquiry-based approaches are considered to have responsive and

reformed beliefs about teaching science. In between these two extremes are teacher science attributions (beliefs) that are considered transitional. The findings are supported by Luft (2009) who asserts that teachers who hold traditional attributions practice teacher-centred pedagogies, and those who hold reformative teacher attributions implement learner-centred enquiry-based teaching and show more improvement in their PCK. It was, therefore, vital in this study to determine whether attributions of the Physical Sciences teachers in my study related to some such aspects. Furthermore, Luft et al. (2011) state that teacher attributions as personal constructs are important to a teacher's practice, as they guide instructional decisions, influence classroom management and impact the representation of the content. Drawing from Weiner (2005), teachers are more likely to stay motivated to try a task again in the future if they have attributed the cause of the original outcome to factors that are internal, unstable and controllable. This implies that teaching strategy is under an individual's control, therefore, if teachers attribute their success to effort they are likely to try the task again in future with similar or more effort.

Mavhunga and Rollnick's (2015) study relates to the current study in the following aspect: the number of participants (16) is identical and the bigger sample was drawn from deep rural areas in both studies. Further, lesson observation was used in both studies as one of the instruments used to generate data. As pointed out in the previous discussions, such similarities provided lessons and guidance on procedures in my study, thereby avoiding pitfalls.

Still in South Africa, Motloung, Mavuru and McNaught (2021) investigated teachers' beliefs and practices in teaching Life Sciences using English, a language that is not their own home language. The study was underpinned by a socio-constructivist perspective, emphasising how one's personal context, including prior experiences, influences the development of beliefs about language use in life sciences classes and the manner in which teaching and learning might occur. The sample comprised six teachers who all spoke English as a second language. The data were generated using structured interviews to ascertain the teachers' beliefs about the teaching of Life Sciences in English to Grade 11 classes and classroom observations to identify their classroom practices.

Findings from the above study indicate that teachers' beliefs about teaching Life Sciences to English second language (ESL) learners were attributed to the interactions that occur in the classroom. The above finding is in line with Mthiyane (2016) who asserts that teacher attributions about teaching strategies are driven by encounters that teachers engage in

throughout many aspects of their teaching. For instance, the process of code-switching (CS) (internal attribution) may arise from a situation where a teacher in attempting to explain a certain abstract concept to learners in English realises that learners struggle to understand the English words (external attribution). Findings further indicate that the practices that Life Sciences teachers attribute their practices to may differ from what they believe to be the best way to teach Life Sciences through the medium of English. Previous research has found that township teachers who are ESL speakers often face a difficult task in teaching Life Sciences using English (Mthiyane 2016). Setati (2002) argues that teaching and learning occur most effectively when learners are familiar with the instructional language. Language is central to issues arising in science classes (Oyoo 2017) and as such, learners need to comprehend English to learn the subject matter meaningfully. This study provided pointers on what to expect in my current study given that Physical Sciences is also taught in English and my participants were also drawn from rural and townships and were probably ESL speakers as Mthiyane indicated.

Findings from the above study (Motloung, Mavuru and McNaught 2021) suggest that schools in South Africa are generally multilingual and multicultural and learners in these schools are mostly ESL speakers. Consequently, Life Sciences teachers resort to code-switching (CS) in order to explain scientific concepts that are problematic to learners (Mthiyane 2016). However, although regarded as an effective process, CS can also contribute to the science language problems that occur in Life Sciences classrooms. Since CS involves moving from one language to another (Prinsloo et al. 2018), it can be difficult for teachers to accommodate all learners from different cultural backgrounds if the teacher is not proficient in all languages spoken by the learners in the class. Adopting one language for CS in a diverse or multilingual classroom means that some learners are left behind thereby denying them their right to learning (Kaushanskaya and Crespo 2019). CS from the attribution theory perspective is an internal attribution which is unstable and controllable and as such it can change over time and, if properly executed, can lead to teacher change.

Findings from Motloung, Mavuru and McNaught (2021) show that teachers attribute their pedagogical practices to both internal and external factors. While the above study was informed by the socio-constructivist theory, the current study draws from Weiner's attribution theory. Participants from the above study (Motloung, Mavuru and McNaught 2021) were Life Sciences teachers but the current study focused on Physical Sciences teachers. However, it should be noted that the two (Life Sciences and Physical Sciences) are sister subjects originating from the same stem: Natural Sciences. Whether the Physical Sciences teachers attributed their

pedagogical practices to similar factors had to be established in the current study. However, the nature of Life Sciences teacher beliefs (attributions) noted above gave me a strong hint on what to expect in the current study.

The national studies on the nature of teacher attributions to their pedagogy which were reviewed, were generally conducted in universities and secondary schools. The studies were mainly qualitative, situated within an interpretive paradigm. Purposive sampling was dominant, although a few employed convenience and multi-stage sampling. Like the international and regional studies, the interview was the common data generation tool. Again, akin to the international and regional studies, teachers attributed their pedagogical practices to both internal (classroom management, teaching strategies, code switching) and external attributions (resources, learner behaviour, learner ability and English Language as a medium of teaching and learning) attributions. Most research settings were urban with only a few rural contexts which justifies the inclusion of the rural segment in the current study. From all the studies evaluated it has become evident that none of them investigated Physical Sciences teacher attributions. The next section critically reviews studies of the influence of teacher attributions on teacher professional growth.

The Influence of Teacher Attributions on Teacher Professional Growth.

This section reviews international, regional, and national literature on the influence of teacher attributions on their professional growth. From the international context: Mathew, Mathew and Peechattu (2017); Supovitz and Turner (2000); de Vries, van de Grift and Jansen (2012); Özdemir (2020) and Luan, Atan and Sabudin (2010) explored the influence of teacher attributions on professional growth**.**

Mathew, Mathew and Peechattu (2017) in India studied reflective practices as a means of teacher development. The study used a qualitative enquiry and data were generated through a structured questionnaire and semi-structured interviews. The participants were 13 students enrolled for the two years B.Ed programme at St. Joseph's College of Education, Mysuru, Karnataka, India and who had opted to specialise in mathematics.

Findings from Mathew, Mathew and Peechattu's (2017) study show that student teacher' attributions related to reflective teaching (internal attribution) influenced their professional growth. The study suggests that when teachers have a desire to carry out systematic enquiry into themselves, they understand themselves, their practices and their learners and this understanding promotes professional growth. Reflections allow teachers to modify and

improve professional practices and this stimulates growth. Consequently, when teachers constantly look into their own actions and experiences, they professionally grow on their own.

Mathew, Mathew and Peechattu (2017) assert that reflective teaching is a process where teachers think over their teaching practices, analyse how something was taught and how the practice might be improved or changed for better learning outcomes in subsequent lessons. In support of the above study, Jacobs, Vakalisa and Gawe (2011) contend that reflective teaching offers teachers the opportunity to renew their practice and to understand the effects of their teaching, which promotes teacher professional growth. They further state that teacher attributions around reflective teaching provide information on how teachers connect with learners meaningfully, thus, promoting sound teaching and learning practice.

Mathew, Mathew and Peechattu's (2017) study also found that teacher attributions to their reflections influenced them to answer the "what and why" questions which gave them certain power over their teaching, resulting in the emergence of autonomy and responsibility in their work, consequently leading to professional growth. Lieberman and Miller (2000) point out that the practice of reflective teaching, reflective inquiry and reflection-on practice, results in gaining personal and professional knowledge that is important to being an effective teacher and in shaping children's learning. Further, Mukeredzi (2014; 2015) posits that reflection assists teachers to resolve their teaching uncertainties and encourages independent professional learning from thinking about classroom experiences, about teaching and about learning processes. Therefore, it was vital to establish the extent to which my participants' attributions related to teacher reflection shaped their professional growth.

Supovitz and Turner (2000) in the USA investigated how the effects of perceptions on Science teaching practices and classroom culture influenced teacher professional development. This was a large-scale quantitative study of 3 464 Science teachers and 666 principals in secondary schools. A model of the theoretical relationship between professional development and student achievement by Allen and Lederman (1998) guided this study which was carried out in rural, urban, and suburban areas, including small towns.

The findings indicate that teachers' perceptions (attributions) related to the use of inquiry-based teaching practice and investigative classroom culture influenced teacher professional growth. Supovitz and Turner's study further found that teacher attributions which influenced their professional growth related to their classroom practice was a product of teachers' beliefs and understanding of the school socio-economic status, such as management support and

availability of resources (laboratory apparatus). These attributions influenced them more to change their classroom practice than did principals' support or the availability of resources. The above study is consistent with Furner and McCulla's (2019) which asserts that specific school contexts have a substantial and differential influence on teacher professional growth across all career stages eventually improving their instructional practices. Attributions which influenced individual teacher professional growth related to lesson preparation and planning emanated from the participants' beliefs about teaching practice and classroom culture. This is given that, as Mukeredzi (2013b:97) asserts, planning allows for thorough preparation and increases teacher efficiency and confidence through "self-interrogating, stepping back, 'pre-playing' and pre-evaluating classroom practice, and teachers develop new knowledge and beliefs on content, pedagogy and student learning." Thus, these teacher attributions around preparation and planning influence teachers' instructional processes (Westhuize, Mosoge, Niewoudt and Steyn 2012) and general classroom practice, consequently, their professional growth.

Supovitz and Turner's (2000) study also found that teacher attributions around lesson delivery influences growth. Professional growth in turn influenced teacher engagement with their learners as they began to allow them to work in cooperative learning groups. When teachers engage with learners they develop a deeper understanding of their challenges and may modify their teaching approaches to suit the ability of their learners and such attributions influence their growth. Ali (2011) asserts that group work encourages deeper learning, interdependence, confidence development and individual accountability. Therefore, teachers need to expose learners to various teaching strategies to realise each learner's potential and, in the process, they experience professional growth. However, Le, Janssen and Wubbels (2018) argue that if teachers are unsure about how to monitor learners' group discussions, manage group work and adequately intervene when necessary or model appropriate collaborative behaviour, this will affect the quality of group learning, collaborative (networking) processes, as well as their professional growth. Therefore, teachers need to understand various ways of handling group work in order to provide each group with an equal opportunity to learn and to avoid gaps in learning.

Teachers believed that by engaging learners in hands-on activities they would understand them better and diagnose their individual strength and weaknesses (Levitt 2002) and, consequently, such attributions influence teacher professional growth. These findings are in line with Ho et al. (2016) who state that hands-on activities encourage students' creativity, critical thinking

and problem solving, promote student independence and aid low-ability learners to overcome their initial handicaps. Whether the participants in the current study's attributions also influenced their professional growth related to classroom practices (strategies, learner creativity, and critical thinking) needed to be established.

In the Netherlands, de Vries, van de Grift and Jansen (2012) studied teachers' beliefs and continuing professional development. Located in a quantitative approach, survey data from 260 Dutch secondary school teachers were generated and analysed using structural equation modelling. The aim of the study was to explore the link between teachers' beliefs about learning and teaching and how they influence their professional development. The study's initial assumption was that beliefs influence working and learning and teachers' beliefs about learning and teaching influence their instructional decisions, which consequently shape professional growth.

Findings from de Vries, van de Grift and Jansen's (2012) study show that teacher professional growth is influenced by teacher attributions related to three aspects: updating knowledge and skills, reflection and collaboration (networking) with colleagues. First, teacher attributions related to their ability to continuously update their knowledge and skills in various pedagogical aspects influenced their professional growth. After their initial teacher education, teachers' practical knowledge expands through experience and teaching practice, but their theoretical knowledge base requires constant and intentional updates to reflect societal and educational developments and innovations. Attributions of teachers from de Vries, van de Grift and Jansen's study, therefore, influenced them to update their knowledge (SCK, PCK and PK) and skills related to classroom practice through collaboration and networking (Middlewood, Parker and Beere 2013) and individual study.

Second, teacher attributions influence teacher reflection and, consequently, their professional growth is enhanced. This is in line with Mathew, Mathew and Peechattu (2017) in the Indian study discussed above. Van de Ven (2009) posits that reflection helps teachers make their tacit knowledge and beliefs explicit, which provides them with more control over routine actions in the classroom and, if necessary, over changes to those actions. Such attributions lead to teacher growth.

Third, findings from de Vries, van de Grift and Jansen's (2012) study show that teacher attributions influence professional growth related to collaboration and networking (McDonald and Klein 2013; Middlewood, Parker and Beere 2013). Collaborative activities that take place

within and outside the school lead to learning, better teaching and learner learning outcomes through their supportive, therapeutic benefits, which can reduce stress and improve confidence (Cheetham and Chivers 2001). Collaboration and networking with colleagues provides teachers with feedback on their work and introduces new ideas and challenges (Kwakman 2003). Scholars argue that engaging in professional learning activities collaboratively with colleagues influences teachers' knowledge and expertise (Topolinski 2014; Peterson 2012). Topolinski's study reveals that engaging in conversations with colleagues at grade level or in department meetings influenced teachers to reflect on their work; like how new learning can be applied in the classrooms (Jimoyiannis 2010). Such attributions related to reflection have a bearing on their professional growth. de Vries, van de Grift and Jansen's (2012) study relates to the current research which sought to understand how teacher attributions influence their development related to classroom practice. Mukeredzi (2009:47) found that such attributions around collegial meetings influenced teacher growth from engaging with colleagues, questioning and observing them, reflecting on what they hear, see and practice, appraising their own and others' practices overtly or covertly. As these general subject dialogues promoted acquisition of new knowledge and skills, attributions significantly influenced teacher professional growth. Such learning was active as teachers.

Özdemir (2020) in Turkey focused on how the school leaders' attributions to content knowledge and evaluation practices influence teachers' professional learning activities and classroom instruction. This was a large-scale study of 425 teachers who worked in 46 elementary and lower secondary public schools within two provinces in Turkey. A questionnaire was used to generate data. The multilevel structural equation modelling (MSEM) version 8 by Muthén and Muthén (2010) was used to analyse data. Findings from Özdemir's (2020) study show that attributions of school leaders influenced teachers' professional growth in areas of practical experimentation and reflective practices were attributed to teachers' good record keeping abilities. From Özdemir's findings it was, therefore, crucial to establish the areas of professional growth in which the attributions of Physical Sciences teachers in this current study were influenced.

Özdemir's (2020) study further shows that teacher attributions influence their professional growth related to supervision. Supervision done by their superiors, such as principals, provided evaluation feedback, fostered experimentation and reflective practice among the teachers and, consequently, influenced their practice. It is through supervision that teachers' strengths and weaknesses are diagnosed and feedback provided leading to teacher growth and teacher

change. Teachers' attributions related to reflection are consistent with de Vries, van de Grift and Jansen's (2012) Netherlands study and Mathew, Mathew and Peechattu's (2017) Indian study discussed earlier. In support of the above, de Klerk (2014) states that teacher attributions related to professional reflection enhance teachers' practice and promote teacher professional growth by developing ways of channelling their teaching and learning processes. Cohen-Sayag and Fischl (2012) further state that reflection in teacher education, as discussed above, is viewed as a tool that influences teacher professional growth as it is perceived as a mediator between existing, and new knowledge. This is given that reflection prompts teachers to think about better ways of performance in subsequent activities, answering such questions as 'what should I have done differently?' It is about "breaking habitual ways of thinking, enhancing the development of meta-cognition, increasing awareness of tacit knowledge, facilitating self-exploration, and working out solutions to the problem" (Nkambule and Mukeredzi 2017:3). In other words, when teacher beliefs focus on engagement in classroom practice through reflection, they are trying to answer questions pertaining to their own teaching such as: what went well or went wrong? What can be done in future to avoid the same mistakes or to uphold the good performance? Such attributions effectively influence teacher professional growth.

Still in the international context, Luan, Atan and Sabudin (2010) in Malaysia studied teachers' perceptions (attributions) of their pedagogical role when conducting science laboratory sessions with computers and how they influence their professional growth. The study was a quantitative survey and participants were science teachers drawn from 42 randomly selected secondary schools in the state of Negeri Sembilan, Malaysia. The data from 209 teachers (148 females and 61 males) were used for data analysis. There were twelve items in the questionnaire: six items related to the student-centred pedagogical role, while the other six related to the teacher-centred pedagogical role.

The findings from Luan, Atan and Sabudin's (2010) study indicate that teacher attributions influenced their practice around learner-centred teaching approaches in science laboratory sessions. This approach engaged learners in authentic classroom activities that assisted them in the process of exploration and the discovery of new knowledge and skills which enhanced their understanding. The Malaysian study findings are in tandem with Prosser and Trigwell (2009) who assert that teachers who view teaching as a process of conceptual change are more likely to utilise learner-centred teaching approaches. Such attributions which benefit learner learning, influence the teachers' desire to learn given that it is only when teachers feel motivated to learn something that they become open to learning (Guskey 2009) and, hence, teacher growth and

change. On the contrary, teachers who perceive learning as the accumulation of information (Prosser and Trigwell 2009) are more likely to employ teacher-centred approaches where they direct the learning process and control learners' activities in the classroom. The teachers impart whatever knowledge and skills that they have to their learners and become the sole authority in the classroom. Such attributions often have an insignificant impact on teacher professional growth. Luan, Atan and Sabudin's (2010) study, just like my current study, focused on science teaching, therefore, it had to be seen whether or not attributions of Physical Sciences teachers in the current study influence teacher pedagogical practices.

Further, findings from Luan, Atan and Sabudin (2010) show that teacher attributions influenced their practice around teaching approaches that emphasise collaborative learning (McDonald and Klein 2013; Jimoyiannis 2010), inquiry-based learning and instruction that fosters problem-solving and critical thinking in relation to science laboratory work, in particular resources for practicals. Tuzlukova (2018) asserts that teachers who adopt critical thinking and problem-solving approaches in teaching, use a variety of teaching material and this approach calls for the teacher to be resourceful. Critical thinking and problem-solving approaches influenced teachers to be resourceful. Resourcefulness in the teaching of science entails the ability to harness all the material that can be used in a lesson to assist learners' understanding of concepts (Wickham 2013). Consequently, attributions which require innovation ultimately lead to teacher growth.

International studies of the influence of teacher attributions on professional growth reviewed above show that they were generally conducted with school teachers. The studies were mostly large-scale quantitative surveys. Findings indicate that teachers' attributions related to collaboration, reflection and updating knowledge and skills which stimulated their knowledge influenced their professional growth. Generally, teacher attributions influenced classroom instruction with notable teaching practices such as engaging learners in hands-on activities and cooperative learning groups. The next section analyses regional studies on the influence of teacher attributions on their professional growth.

On the regional platform, a literature search did not yield much academic work. Limited studies which are discussed in the next section were carried out by Kavenuke and Muthanna (2021), Owusu-Fordjouri (2012) and Maende, Luvai and Mbayah (2014).

Kavenuke and Muthanna (2021) in Tanzania investigated the influence on professional development of teacher beliefs and perceptions related to the concept 'critical pedagogy' and

the challenges they encountered while employing critical pedagogy in teaching. This was a qualitative case study which employed semi-structured interviews and direct classroom observations in data generation. In teaching, critical pedagogy encourages the use of problem-solving techniques in order to allow and motivate students to question the knowledge they receive (Kinyota and Kavenuke 2018).

The findings from this study showed that teacher professional growth around critical pedagogy was influenced by attributions related to good teacher-learner friendly relationships, including teacher handling of learners which encouraged dialogue and interactions. Dialogic interactions lead to critical self-assessment which in return, influences better understanding of the subject content. A better understanding of subject content leads to teacher growth and change (Kinyota and Kavenuke 2018). Mukeredzi (2013) in confirmation notes that a conducive learning environment provides a platform devoid of both physical intimidation, as well as cognitive and emotional frustration, which allows for a free exchange of ideas where learners learn and laugh together. Such an environment makes the classroom safe for both the teacher and the learners. Consequently, a good teacher-learner relationship and learner handling has positive benefits for both learners and teachers and, in this case, it leads to teacher professional growth.

Findings from Kavenuke and Muthanna (2021) further indicate that teachers' attributions influence their practice related to critical pedagogy (problem-solving technique). This approach influenced the teachers to adapt to and handle crowded classes (Cortes, Mousa and Weinstein 2012; Petrie 2013), improvised teaching and learning resources and laboratory apparatus (Janes 2013), as well as using correct English terms related to the subject (Garcia and Otheguy 2019). Drawing from Weiner (2005) these are internal attributions which are unstable and controllable: eventually the teacher can manipulate them during classroom practice which may lead to teacher change. Ramnarain and Hlatswayo (2018) assert that the implementation of CAPS in Physical Sciences, especially its emphasis on inquiry-based learning which is linked to critical pedagogy, has been frustrated by the shortage of resources in schools and large classes which may be contributing to learner failure and this demoralises teachers, consequently, affecting their professional growth. However, Mukeredzi (2009) posits that contradictions of that nature give rise to effective ways to mediate their effects through creative and innovative approaches to overcome them and such a process brings about professional change and development. This is given that teachers creatively resist the constraints within their classroom and school contexts to reconfigure what it means to be a teacher.

The above Tanzanian study is related to the current study in that both employed a qualitative case study design, semi-structured interviews and direct classroom observations for data generation. I was able to draw lessons on methodological processes from this Tanzanian study.

In Ghana, Owusu-Fordjouri (2012) investigated the attitudes (attributions) of Integrated Science teachers in senior high schools and their impact on their instructional practice. The study employed a descriptive survey design using the quantitative research approach. Participants in this study were 138 Integrated Science teachers randomly sampled from the Central Region of Ghana. The study employed the questionnaire and observation checklist as quantitative instruments and the interview as a qualitative instrument. A closed-ended structured questionnaire was used. The quantitative data were analysed into simple frequencies and percentages, whereas thematic analysis was used for the qualitative data. Statistical Package for Social Sciences (SPSS) version 20 was used for the quantitative data analysis.

Findings from this study indicate that teachers' attributions related to SCK influenced their attitude towards the subject and their classroom practices. Findings also show that teachers who have adequate SCK have a positive attitude towards the subject, are motivated and, therefore, are likely to grow. Contrarily, teachers who lack SCK have a negative attitude, are demoralised and are less likely to change (Owusu-Fordjouri 2012). Citing Cogilll (2008) Mukeredzi (2020) points out that teachers with strong CK endeavour to teach in a more interesting and dynamic way. Such an approach to teaching enhances professional growth as CK is a significant aspect of teaching since it affects planning, task setting, questioning, explaining, giving feedback and assessment (Mukeredzi 2020). Those teachers with little CK may shy away from the more difficult aspects of the subject, or approach their teaching in a didactic manner (Mukeredzi 2020) which may limit professional growth.

Azure (2015) in confirmation asserts that some teachers do not have basic knowledge in some of the science topics in the curriculum and are, therefore, demoralised to teach them whenever they are to teach such topics to the learners. Attributions to knowledge on such subject matter of the curriculum that the teachers are required to teach further influences their overall perceptions and attitudes to the subject which also influences their professional growth. Teachers who possess SCK are confident in their practice (McDonald and Klein 2013), as highlighted by Mukeredzi (2020), and can explore new teaching approaches, which enhances growth. Further, given that SCK is internal, unstable and controllable, teachers can manipulate it to improve their practice, which fosters growth.

Further, findings from the above Ghanaian study indicate that teacher attributions related to Pedagogical Knowledge (PK) (internal attribution) influence their attitude towards Integrated Science and practice (Mosston and Ashworth 2013). This assertion is supported by Azure (2015) who states that lack of teaching skills and competencies among teachers is the result of their poor instructional approaches and their negative attitude towards Integrated Science as a subject. It is further noted from the Ghanaian study that Integrated Science teaching skills are highly technical, therefore, teachers teaching the subject should have enhanced skills which should be continuously developed. Drawing from the theoretical framework (Weiner 2005), PK is an internal attribution which the teachers have total control over and this could change over time. In this case, teachers could make some effort to enhance their mastery of PK which could lead to their professional growth.

This study is, therefore, related to my current study in that the focus in both studies was on Sciences. Integrated Science is a combination of Physics, Chemistry and Biology whereas Physical Sciences is a combination of Physics and Chemistry only. That slight difference did not affect the lessons that I learnt about teachers attributions related to SCK and PK which influenced their practice. This study was, therefore, an eye opener of what I was likely to expect in my current study.

Maende, Luvai and Mbayah (2014) investigated the influence of teacher perceptions on the use of resources inclusive of laboratory equipment on professional development in public secondary schools in Kenya. The study adopted a descriptive survey design. A saturated sampling technique was used to select one district quality assurance and standards officer, 30 head teachers and 150 HODs. A simple random sampling technique was used to select 131 teachers, while 360 students were selected based on Israel's (n.d) formula of determining sample size. Data were generated using questionnaires and focus group discussions. Quantitative data from closed-ended parts of the questionnaire were analysed using descriptive statistics, while qualitative data were analysed thematically.

The study found that teacher attributions influenced their classroom practice around lesson delivery in relation to the choice of teaching materials, laboratory apparatus, including textbooks (external attribution). Cogill (2008) points out that knowledge of learning materials is essential not only for teaching itself but also for the choice and evaluation of text books, computer software and teaching aids. Thus, this ability influences teacher professional growth. This is consistent with Cohen and Hill (2000) who discovered that teacher use of textbooks

influenced their professional growth in their classroom practice. Using of textbooks not only influences teaching and learning in the classroom setting but also guides the teacher on how much content to cover in each session. Contrarily, Darling-Hammond (2003) argues that using textbooks makes little difference if teachers do not know how to use them effectively. Further, Maende, Luvai and Mbayah found that teacher professional growth was influenced by teachers' attributions related to effective use of the chalkboard. It, therefore, needed to be established whether Physical Sciences teachers' attributions in this current study also influenced their professional growth related to chalkboard work or use of textbooks.

Attributing professional growth to effective chalkboard is supported by Kgomo (2013) who states that teachers need to model legible and neat handwriting as students copy what their teachers write on the chalkboard. In cases of poor or illegible handwriting on the chalkboard, learners may copy work incorrectly, leading to inaccurate facts being learned, consequently ruining their learning and understanding (Blease 2014). Good handwriting is generally viewed from three aspects: letter formation (form and slant), size and spacing. This is probably the way in which teachers in Maende, Luvai and Mbayah's (2014) study were influenced. Maende, Luvai and Mbayah's study found that teacher attributions around classroom practice positively influenced teacher professional growth related to their motivations to effect change in all their lessons, making them more practical and engaging, which involved the use of resources like laboratory apparatus (Fischer et al.), other learning materials and charts with maps. Moore (2013) argues that a deep understanding and the ability to learn new concepts or topics requires direct experience with concrete objects. Turning theory-based lessons to practical lessons using concrete resources probably enhanced teacher professional growth since it was bound to benefit learners in terms of mastery of concepts.

The regional studies on the influence of teacher attributions to their professional growth analysed above were conducted among teachers, HODs and head teachers. Generally, these studies adopted mixed method approaches. Like international studies, the interview was the main data generation tool. The findings indicated that teacher attributions related to the use of teaching resources, teacher-learner friendly relationships and learner handling, possession of SCK, and PK and the use of English as language of instruction, influenced their professional growth. It also emerged that teacher professional growth emanating from teacher attributions influenced the choice of learning activities and learning materials including textbooks, chalkboard and use of different teaching strategies. However, none of the studies critically evaluated or investigated Physical Sciences teachers.

In the following section, I discuss national studies related to teacher attributions and their influence on teacher professional growth. In the national context, studies evaluated were conducted by Kibirige and Maponya (2019), Semeon and Mutekwe (2021) and Ramaila and Ramnarain (2013).

Kibirige and Maponya (2019) studied Grade 11 Physical Sciences teachers' perceptions (attributions) on practical work in classrooms in Mankweng Circuit. This was a qualitative case study and participants were Grade 11 Physical Sciences teachers all purposively drawn from different high schools in Mankweng circuit in Limpopo province. Data were generated through face-to-face interviews, non-participant classroom observation and teachers' portfolios (which included lesson plans, designed practical activities, work sheets for practical work and assessment activities). Data were analysed thematically using open, axial and selective coding.

Findings indicated that Physical Sciences teachers' attributions influenced their professional growth around practical work, scientific investigations and experiments in relation to the use of demonstrations and explanations. This observation agrees with Ramnarain and Hlatswayo (2018) who reported that teachers preferred to demonstrate during practical work for learners to see and learn at the same time (Josephsen and Hvidt 2015). Besides Hlatswayo (2018), in Kibirige and Maponya's (2019) study, teachers' attributions influenced their professional growth around practical work with laboratory resources. Resource and laboratory equipment limitations influenced and prompted their creativity to come up with other ways of presenting effective lessons. Such processes often foster professional growth. Insufficient resources in schools have been reported by Kanamugire et al. (2019) who state that a lack of laboratory facilities is a long-standing challenge in schools. What it implies is that by adopting use of demonstrations (Wickham 2013; Vhurumuku 2010) due to lack of resources for practical work, the teachers in Kibirige and Maponya's (2019) study were innovative in the face of challenges and this innovation was a sign of professional growth. Teachers may also have challenges to teach practical work as a hands-on learning experience for learners as advocated by Cossa and Uamusse (2015), who emphasise that during practical work, learners must observe and manipulate objects. The teachers' reluctance to facilitate authentic student practical work may indicate the influence of the teachers' attributions related to knowledge gaps to design suitable activities to teach science topics. Lack of knowledge would be an internal attribution that the teachers could change.

Kibirige and Maponya's (2019) study where participants were also Physical Sciences teachers is related to my current study and this pointed me to aspects to look out for, for instance, whether their attributions to resource availability for practical work, teacher practice in that regard and also teacher of knowledge influenced their professional growth. Secondly, the three instruments used to generate data were similar to what I used in this study which gave ideas on how to handle and analyse data from different sources. In addition, this study in a South African context in the same subject area was an eye opener regarding the influence of teacher attributions on their professional growth.

Again in the South African context, Semeon and Mutekwe (2021) studied Physical Sciences teacher perceptions (attributions) on the use of language in classrooms and how that influenced their professional growth. The study revealed that Physical Sciences teachers attributions related to difficulties with meanings of non-technical words used in science context influenced and compromised their effectiveness in the teaching and learning of science. The study adopted a quantitative approach and data were generated through a closed-ended questionnaire. A sample size of 37 Physical Sciences teachers was drawn from high schools in the Ngaka Modiri Molema district of the North West province of South Africa. In addition, learners in Grades 10, 11 and 12 participated in this study which was informed by Vygotskian socio-cultural theory (SCT).

Findings from Semeon and Mutekwe (2021) indicate that teachers' attributions influenced their professional growth around language use or discourse of the science classroom. Teachers' professional growth stimulated them to use the correct Physical Sciences terminology during lesson delivery (Madonsela 2016; Garcia Johnson and Seltzer 2017). Consequently, from the professional growth, teachers adopted teacher-learner interactive approaches which gave rise to conducive environments for learning the Physical Sciences terminology. Turuk (2008) concurs that teachers mostly interact with learners through talking using science language, using scientific models and equations and conducting experiments. It is through teacher-learner interaction that teachers understand the strengths and weaknesses of their learners. Such awareness is vital for their practice (Mukeredzi 2016).

In the Gauteng Province of South Africa, Ramaila and Ramnarain (2013) explored Physical Sciences teachers' perceptions (attributions) and experiences of lesson planning in a new curriculum and how that influenced their professional growth. The study adopted a mixed methods approach, combining both quantitative and qualitative research approaches. Data were

generated through a structured questionnaire that was posted to 660 high schools from urban, township and rural contexts of Gauteng Province. The findings that emerged from the questionnaire analysis were then explored further by means of interviews with a smaller sample of 10 teachers.

Findings from Ramaila and Ramnarain's (2013) study showed that teacher attributions around lesson planning influenced their professional growth, as classroom effectiveness in the new curriculum was greatly enhanced through this kind of preparation. Through professional growth, teachers realised that the process of engaging in writing a lesson plan enabled them to explicate their ideas on how the lesson should unfold thereby enhancing their understanding (Mukeredzi 2016) of the new curriculum which probably further stimulated their professional growth. Through lesson planning, teachers were able to set the objectives, identify the resources to be used and the teaching approaches, which also helped them to understand the new curriculum. These findings are consistent with ideas of Moore-Cox (2017), who asserts that the lesson plan serves as a support mechanism in planning deliberately for difficulties they may encounter in addressing curriculum implementation challenges. The ability to think through, prepare a lesson plan and pre-play that lesson which accommodates possible challenges is a sign of professional growth demonstrated by the teachers. Lesson planning reminds the teacher of the specific goals to be achieved through classroom teaching (Moore-Cox 2017) and provides a picture of what is to be pursued and what is to be avoided.

Further, from the Gauteng study, findings show that teacher attributions which influenced their professional growth also influenced collaboration and networking among teachers within a community of practice (Middlewood, Parker and Beere 2013). Through collaboration and networking in the community of practice, emanating from their attributions, teachers shared ideas on tackling certain topics in the classroom especially those that were new in the curriculum. Such engagements enabled them to teach topics more effectively leading to professional growth. Proponents of collaboration and networking such as McDonald and Klein (2013) indicate that such avenues in the educational system are important in facilitating acquisition of new knowledge (leading to professional growth), promoting creativity and improving the general quality of education. In addition, Jimoyiannis (2010) suggests that teachers' knowledge of Science can be cultivated by engaging teachers in realistic activities which involve learning from colleagues.

Ramaila and Ramnarain's (2013) study with its focus on Physical Sciences teachers where the participants were drawn from urban, township and rural contexts like in the current study, informed my study with regard to the influence of teacher attributions on professional growth.

Nationally, studies discussed above were all conducted with Physical Sciences teachers teaching in high schools focusing on their perceptions (attributions) and the influence of those attributions on professional growth. Generally, the studies used mixed methods approaches, and data were generated through questionnaires, face-to face interviews, document reviews and non-participant observations. Findings indicate that teacher attributions to laboratory resources, teacher-learner collaboration and lesson preparation influenced their professional growth related to classroom practice. The next section sums up the chapter.

Chapter Summary

The aim of this study was to gain insight into the nature of rural, urban and township Physical Sciences teacher' attributions and how these shape their professional growth. All the literature consulted and analysed from international, regional, and national contexts focused on primary and secondary school teachers, as well as university students. Generally, most of the studies focused on science teachers in different grades. Only one study focused on Grade 12 Physical Sciences teachers. While this was healthy for comparison, it also indicated limited research in this phase – a gap to which the current study would contribute.

Most studies related to Research Question One (nature of teacher attributions) were guided by Weiner's theory of attribution. In Research Question Two, the studies evaluated were guided by other theoretical frameworks and conceptual frameworks and one theory was adopted. Methodologically, most studies were qualitative within the interpretive paradigm and interviews were generally the main data generation instrument used. The studies employed different sampling methods although purposive and convenience sampling designs were popular.

With regards to Research Question One on the nature of teacher attributions, international, regional, and national studies critically analysed and discussed above investigated primary and secondary school teachers. What generally emerged from the literature evaluated was that teachers attributed their pedagogical practices to both internal and external factors. It emerged that teachers attributed their practices to internal attributions such as classroom management, teaching strategies and code switching (CS). Drawing on Weiner's (2005) attributions theory, such internal attributions are unstable and controllable. Findings also revealed external

attributions (stable and uncontrollable) that teachers attributed their pedagogy to which included resources, learner behaviour, learner ability and English Language as a medium of teaching and learning.

Most of the studies were conducted in urban contexts, with a few in the rural and township contexts. This justified the inclusion of these two contexts in the current study. The fact that from all the studies critically reviewed none of them investigated the nature of Physical Sciences teacher attributions further justified the need for the current study.

With regard to literature addressing Research Question Two on the influence of teacher attributions on professional growth, findings from the international context indicated that teacher attributions influenced their professional growth related to collaboration (networking), reflection and updating knowledge and skills. It also emerged from the international context that teacher attributions around classroom practice influenced their instruction and teaching practices related to engaging learners in hands-on activities and cooperative learning groups.

From the regional arena, literature indicated that teacher professional growth influenced by attributions related to the use of teaching resources, teacher-learner relationships, possession of SCK and PK and use of English as language of instruction. Further from the literature, teacher attributions that emerged related to classroom practice also influenced teacher choice of learning activities and learning materials including textbooks, chalkboard work and use of different teaching strategies.

Literature reviewed from the national context showed that attributions influenced teacher professional growth on laboratory resources, teacher-learner collaboration and lesson preparation. While studies critically reviewed from the local context explored Physical Sciences teachers as alluded to above, only one investigated Grade 12 Physical Sciences teachers. Therefore, this study attempted to contribute to that gap.

Having critically analysed and discussed in some detail related literature, the next chapter describes the theoretical framework by Weiner (2005) and Bell and Gilbert's (2005) Aspects of Professional Learning that underpinned the current study.

CHAPTER THREE

THEORETICAL FRAMEWORK

Introduction

This research investigated Physical Sciences teacher attributions to their pedagogical practices and how these attributions influence their professional growth. The previous chapter reviewed relevant literature on teacher attributions from the international, regional, and national contexts. The literature illustrated that teachers attributed their pedagogical practices to both internal and external factors. This chapter discusses the theoretical framework which guided the study.

This study draws on Weiner's (1986) theory of causal attribution as the overarching theory, complemented by Bell and Gilbert's (1996) Aspects of Professional Learning theory. Given that the study was about teacher attributions, Weiner's (1986) theory of causal attribution was appropriate, due to its focus on perceptions, beliefs, attitudes and feelings. This theory specifically enabled framing the study including generating, unpacking and understanding data and explaining findings addressing Research Question One on the nature of Physical Sciences teachers' attributions to their pedagogical practices. However, Weiner's (1986) theory of causal attribution was not helpful in addressing and explaining data answering Research Question Two on how attributions influence Physical Sciences teachers' professional growth. Consequently, a complementary theory, Bell and Gilbert's (1996) Aspects of Professional Learning, was roped in and used to help address Research Question Two.

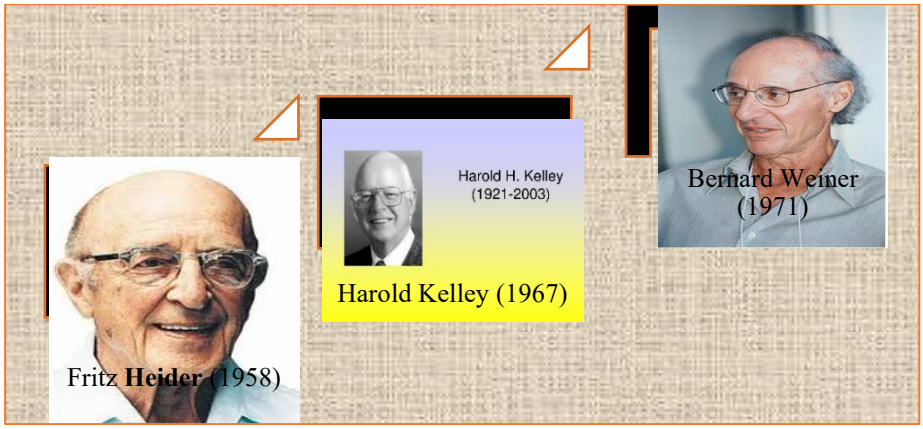
A theoretical framework is defined by Grant and Osanloo (2014:13) as a "blueprint for the entire dissertation inquiry that serves as the guide on which to build and support your study, and also provides the structure to define how you will philosophically, epistemologically, methodologically, and analytically approach the dissertation as a whole." In other words, a theoretical framework provides the foundation to the study, where it is grounded, sustained, carried out and reported. In this study, the theoretical framework employed guided choices regarding developing research questions, data generation and interpretation, as well as explaining findings.

The discussion on the theoretical framework covers their historical development, principles and application in the study, as well as weaknesses, including how these shortfalls were dealt with to minimise their impact on the findings.

The Historical Development of Attribution Theory

Attribution theory falls in the field of social psychology and broadly aims at explaining how individuals determine the causes of an event or behaviour, as well as the consequences of such attribution on their subsequent behaviour. Humans by nature are an inquisitive species (Heider 1958) and as such they always try to explain any event that occurs. Attribution theory attempts to describe and explain the mental and communicative processes involved in everyday explanations, most typically explanations of individual and social events (Weiner 1985). Thus, attribution theory, is concerned with the "why", "how" and the "what" by which people process information in attempting to understand events, judge and act on those events.

Figure 3.1 Major contributors to attribution theory



Source: Google search: www. pictures. Heider/ Kelley/ Weiner (2022)

As illustrated on Figure 3.1 above, originally attribution theory was introduced by Fritz Heider (1958. His ideas of this theory were then developed by Harold Kelley (1967; 1973) and expanded by Bernard Weiner (1971; 1976; 1986; 2005).

Fritz Heider's (1958) Theory of Attribution

Heider (1958) is regarded as the founder of attribution theory (Kelley 1967) and was the first to introduce the concept of 'perceived locus of causality' using it to define interpersonal perceptions of one's environment. From his perspective, this theory explains how individuals perceive the causality of different events: whether they are externally or internally based. Causality (causal attribution) is the process whereby people assign causes to their own or others' behaviour. For instance, Physical Sciences teachers may perceive that their pedagogical approaches are caused by factors outside their control like learners' family background (external) or they may be perceived as due to their lack of SCK (internal). These initial

perceptions are called attributions. Psychologists used these attributions to better understand individual's motivations and competence. Heider (1958) states that understanding an individual's perception of causality opens doors to a better understanding of how to motivate an individual in specific tasks thereby increasing levels of pedagogical competence and classroom practice in general.

Heider (1958) states that attribution is a three stage process:

1. Behaviour is observed;
2. Behaviour is determined to be deliberate;
3. Behaviour is attributed to internal or external causes.

Drawing from Heider's (1958) theory, teacher attributions (beliefs, attitudes and perceptions) are based on observation. Thus, with regard to observed behaviour, Physical Sciences teachers' pedagogical practices in handling learner diversity, their selection of teaching approaches, as well as material to be used, could be attributed to what they would have observed. For example, if they observe that their learners are of mixed ability, this can influence their choice of pedagogical approaches, consequently, lesson preparation and delivery will be attributed to learner ability. The second stage states that behaviour is determined to be deliberate, in other words teacher attributions are not accidental but they are based on observations. Heider (1958) further states that behaviour is attributed to internal or external causes. This is discussed below.

Internal vs External Attribution

External attribution, also called situational attribution (Heider 1958), refers to interpreting someone's behaviour as being caused by the individual's environment. The theory states that these factors are external and the individual has little or no control over such factors. For example, Physical Sciences teachers' pedagogical styles could be attributed to availability of resources which is an external factor: they cannot control resource availability. Heider (1958) further asserts that individuals are more likely to associate unfortunate events with external factors than with internal factors. With reference to classroom practice, Physical Sciences teachers, for example, could attribute poor learner performance to learner behaviour or attitude towards the subject (external cause) without focusing on their own pedagogical styles (PK, PCK, SCK) (internal causes).

With reference to internal attribution, also called dispositional attribution, Heider (1958) states that the process involves assigning the cause of behaviour to some internal characteristic, such

as likeability and motivation, rather than to outside forces. This concept overlaps with the locus of control, in which individuals feel they are personally responsible for everything that happens to them. Locus of control according to the theory implies that the teachers can manipulate the cause since it is under their control. For example Physical Sciences teachers could attribute good learner performance to their good pedagogical styles such as possession of adequate SCK, PK or PCK (internal factors). Since these attributions are internal to the teacher they are controllable and can change overtime. Heider's (1958) ideas were taken up by Harold Kelley (1967).

Harold Kelley's (1967) Attribution Theory

As alluded to above, attribution theory was further developed by Harold Kelley (1967). Kelley (1967) just like Heider (1958) states that behaviour is attributed to internal and external causes. However, unlike his predecessor, Harold Kelley's attribution theory emanates from the principle of covariance. In his covariation model, which is also known as his ANOVA Model (Analysis of Variance Model), Kelley suggests that people attribute a behavior to whatever it covaries with. The covariation principle states that "an effect is attributed to the one of its possible causes with which, over time, it covaries" (Kelley 1973:108). Simply put, a certain behaviour is attributed to potential causes that appear at the same time. Just like Heider's (1958) attribution theory, Kelley asserts that causes of an outcome can be attributed as internal or external or a combination of both (Kelley 1973). Kelley's model suggests that attributions are made based on three criteria:

1. Consistency;
2. Consensus;
3. Distinctiveness. (Kelley 1973)

Consistency relates to the similarity of the behaviour across time and situations. In other words attributions from one person must be consistent even if time changes. In other words, the people (Physical Sciences teachers) always display the same behaviour in front of similar stimuli at different moments in time. In this study, therefore, Physical Sciences teacher attributions highlighted in Interview One on the nature of Physical Sciences teacher attributions would be expected to be consistent with attributions identified during lesson observations and document reviews. The consensus variable covers information comparing the behaviour in question with that of others. Other people (Physical Sciences teachers) in the same situation are expected to show the same attributions. In this study, since all teachers were teaching Physical Sciences in

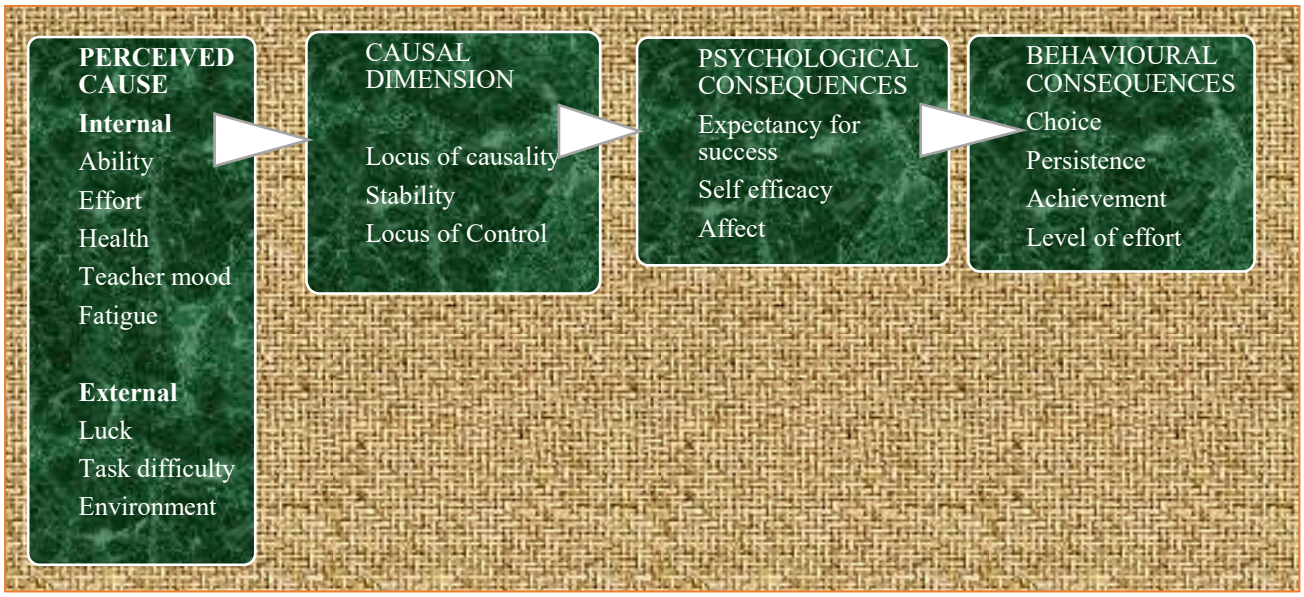
Grade 12 (same situation), the nature of their attributions to their pedagogy would be expected to be more or less the same. Further, teachers in the same rural context would be expected to attribute their pedagogical practices to common factors, for instance, resource availability or in-school support. Kelley (1973) in the review of this theory states that Consistency is used most while Consensus is used least.

Distinctiveness compares the behaviour in question with other relevant behaviours displayed by the Physical Sciences teachers. The theory predicts that high consensus, high distinctiveness, and high consistency are associated with stable causal factors external to the person while low consensus, low distinctiveness, and high consistency are associated with unstable causes within the person (Kelley 1973). Bernard Weiner expanded the ideas of Kelly.

Bernard Weiner's (1971) Theory of Attribution

After Harold Kelley (1967), Bernard Weiner (1971) took over and advanced the theory of causal attribution which has been widely used in achievement-related educational settings (Petrie 2013; Riley and Ungerleider 2012). Just like his predecessors, Weiner suggested that behaviour is attributed to internal and external factors. However Weiner did not adopt Kelley's ANOVA model. Further, Weiner in addition to locus of control added two other aspects to the causal dimension in order to explain internal and external factors and these will be discussed in detail below. Thus, Weiner proposed a model (see Figure 3.2 below) which he used to explain the causes of people's behaviour and the consequences thereof.

Figure: 3.2 Weiner's Attribution Model.



Source: Weiner (1986)

Weiner's (1986) attribution model shows the way people explain their success or failure in achieving their goals or fulfilling a task. Weiner identifies three dimensions that describe potential causes of success/failure: locus of causality, stability and locus of control. These are discussed below. Figure 3.2 above illustrates that Perceived Causes of human behaviour can be internal or external (Locus of causality). These causes further differ according to the Causal Dimension. For example, Physical Sciences teachers may attribute their learner performance to an external cause (locus of causality) such as learner ability, which is not controllable (Causal dimension – locus of control). The causal dimension regardless of whether it is locus of causality, stability or locus of control, will have psychological consequences which in turn influence teacher behaviour.

Locus of Causality

Weiner's dimension of locus of causality relates to the origin of the cause which can be internal (linked to the person) or external (linked to the situation). Internal causes are the skills displayed by the person, as well as the effort this person invests in the task. In the context of this study, Physical Sciences teachers could attribute their pedagogical practices to adequate SCK (Locus of causality), for example, and such attributions are within the teacher (Locus of control). This first dimension determines the pride (or value) that the person will experience in the event of goal achievement: higher value will be derived from an attribution to internal causes (Weiner 1986). Success attributed to internal causes will have positive psychological consequences on Physical Sciences teachers, such as an increase in their self-efficacy and this will motivate them to put more effort into their pedagogical practices (behavioural consequence).

Stability

The second dimension, stability, defines the reliability of the causes (Weiner 1986). Such causes can be considered as stable or unstable, according to whether they are likely to recur or not. Stable causes are people's skills and task difficulty; unstable causes are the amount of invested effort and the luck encountered. In this study Physical Sciences teachers may attribute their pedagogical practices to lack of PK, for example. PK is an internal attribution which is stable because the teacher has total control over it. However, if they attribute it to lack of science equipment, then this is an external and unstable attribution.

This second dimension determines the expectancy that people will develop regarding the probability of their success/failure the next time they are exposed to the same situation. In the

case of a stable cause (for example PK, as mentioned above), Physical Sciences teachers may expect a similar outcome in learner understanding, while in the case of an unstable cause (for example learner ability) Physical Sciences teachers may expect a different outcome. If Physical Sciences teachers attributes their pedagogical practices to a lack of effort (internal, unstable cause), they may feel motivated to do better next time (psychological consequence) in their lesson preparation and delivery as this cause can be changed (unstable) and depends on them (internal). Conversely, Physical Sciences teachers who attribute poor learner performance to their lack of SCK (internal, stable cause) may feel depressed and demotivated (psychological consequence) as this cause would be seen as more difficult to modify (Weiner 1986). When attributions lead to positive affect and high expectancy of future success, such attributions result in greater willingness to approach similar achievement tasks in the future (behavioural consequence) than those attributions that produce negative affect and low expectancy of future success. Eventually, such affective and cognitive assessment influences future behavior when individuals encounter similar situations. In this study, for example, Physical Sciences teachers may attribute their lesson delivery to availability of resources: if the lesson was successful, the teachers may be encouraged to repeat the same process in future. The next section discusses locus of control which is the third causal dimension proposed by Weiner (1986).

Locus of Control

With reference to controllability, Weiner's (1986)'attribution theory states that internal attributions are controllable and the individual can manipulate them. However, external attributions are not controllable and the individual has little or no control over them. For instance, teaching approaches like group work or individual practical demonstrations (internal) adopted by Physical Sciences teachers are controllable but laboratory equipment or learners' family backgrounds are uncontrollable.

Against Weiner's (1986) model above teacher attributions can focus on broad factors (internal and external). In this study, therefore, Physical Sciences teachers would be expected to highlight their attributions (possible explanations) regarding their pedagogical practice and performance in this subject. Lack or availability of text books, science laboratories, progressed learners, learner attitude towards the subject are all external attributions. Physical Sciences content knowledge (SCK), teacher mood, health, abilities, effort, among others, are internal attributions which may affect their practice as teachers and their professional growth in these secondary schools. When teachers have an internal attribution style, they tend to feel personally

responsible for learners' achievements (Weiner 1986). Learner achievement is then attributed to factors within the teacher. In contrast, when teachers have an external attribution style, they believe that they are not primarily responsible for learner achievement (psychological consequence). Something from outside of the teacher is believed to cause the learners' ability. In such cases teachers may not put effort (behavioural consequence).

The following sections discuss some of the criticisms levelled against attribution theory.

Critique of Attribution Theory

Weiner (1986) in his theory noted that while people strive to find reasons for behaviours, they fall into many traps of biases and errors. The following are examples of attributional biases and errors which were the basis for criticism.

Self-serving Bias

Weiner (1986) states that self-serving bias is a process of attributing dispositional and internal factors for success, while external and uncontrollable factors are used to explain the reason for failure. For example, Physical Sciences teachers may attribute learners' good classroom behaviour and respect to their good classroom management skills and competence whereas if the same learners are not well behaved and are rowdy it could be attributed to their family background (external, uncontrollable factor). Weiner (1986) further states that self-serving bias is strongly related to the fact that people want to protect their self-esteem. However, an alternative information processing explanation is that when the outcomes match people's expectations, they make attributions to internal factors (Kelley 1973); for example, a Physical Sciences teacher who demonstrates a practical experiment on titration in chemistry and achieves the objective might believe it was because of his/her adequate PCK. Whereas when the outcome does not match his/her expectations, he/she makes external attributions or excuses saying, for example, the chemicals had expired or the test tubes were contaminated. Literature (Riemer 1975) states that one of the motivations for attributing causes to events (external causes) would be the protection of one's self-esteem. To defend their ego, Physical Sciences teachers may be prone to overestimate the importance of internal causes in the case of success to build pride and confidence, and to overestimate the importance of external causes in the case of failure to avoid an effect on their self-esteem. Further literature (Feather and Simon 1971) asserts that attributions made by an individual may be biased by their desire to appear in a favourable way in front of others.

Fundamental Attribution Error (FAE)

Another criticism noted by Kelley (1973) in his review of attribution theory is what he called the Fundamental Attribution Error. FAE is the tendency for people to underemphasise situational and environmental explanations (external factors) for an individual's observed behaviour while overemphasising dispositional-and personality-based explanations (internal factors). FAE is most common when people explain and assume the behaviour of others. In other words, it is a belief that "what people do reflects who they are". For example, Physical Sciences teachers may attribute learners' poor performance in a Physics paper to mere laziness without considering external factors around the learner like family background, teacher methods and resources. The error is in seeing the learner's performance as solely reflective of their personality without considering other factors around the learner.

However, notwithstanding the criticisms discussed above, Literature (Petrie 2013; Riley and Ungerleider 2012; Janes 2016) indicates that Weiner's attribution theory has been widely used in educational settings and specifically in classrooms to explain learner and teacher successes and failures. This is due to its holistic focus (internal and external causes) on teacher behaviour. In this study, the aim was to explore Physical Sciences teacher attributions to their pedagogical practices and their influence on professional growth. As such Weiner's (2005) attribution theory enabled understanding and explaining the nature of Physical Sciences teachers' attributions to their pedagogy (explanations of teaching approaches, selection of teaching and learning material and lesson delivery etc). On each interview question posed, the teachers were asked to reflect on their pedagogical practices and their professional growth without hurrying them, but enabling them to give honest, genuine and objective answers and minimise self-serving bias and fundamental attribution error.

In addition, in this study, while Weiner's theoretical framework could assist with understanding the nature of Physical Sciences teacher attributions to their pedagogical practices the theory was not helpful in analysing and describing answers to Research Question Two about the influence of teacher attributions on their professional growth as alluded to earlier. Consequently, after surveying literature, I found Bell and Gilbert's (1996) Aspects of Professional Learning suitable to help understand and explain the ways in which Physical Sciences teachers' attributions influenced their professional growth given its three interconnected domains of professional learning influence: personal, social and occupational. I discuss the theory below.

Bell and Gilbert's (1994) Aspects of Professional Development

Bell and Gilbert (1994) developed a model of professional development based on three domains of influence. In this earlier model of professional development, they identified three interconnected domains of influence as effective in influencing professional development: personal, social and occupational. Bell and Gilbert viewed professional development as an ongoing process of reflection on one's practices and learning therefrom, which leads to development of new skills and knowledge and eventually professional growth. Their conception of professional development was consistent with views of Villegas-Reimers (2003) who sees the concept as implying long-term process that includes regular opportunities and experiences planned and unplanned that promote growth and development in the profession. Thus, in their model of professional development, Bell and Gilbert identified the three aspects (personal, social and occupational) which they viewed as vital for any teacher professional development. For these authors, it was through the impetus of these three interconnected domains of influence that teacher professional development occurred. However, the authors reworked and modified their model of Aspects of Professional Development two years later and called it 'Aspects of Professional Learning' which I discuss in the following section.

Bell and Gilbert's (1996) Aspects of Professional Learning

Bell and Gilbert (1996) reworked their model and modified the name, changing it from professional development to call it Aspects of Professional Learning. However, the structure or domains of influence of the model (personal, social and occupational) remained unchanged.

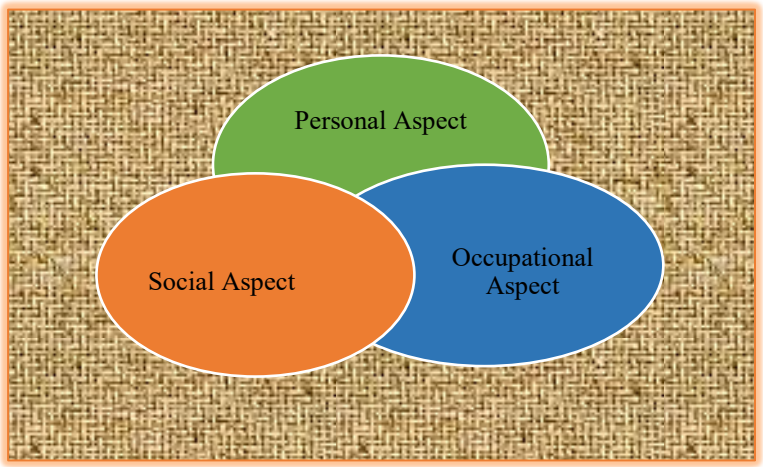
According to Fraser et al. (2007) teachers professional learning is understood as representing the processes, whether intuitive or deliberate, individual or social, that result in specific changes in the teacher's professional knowledge, skills, attitudes, beliefs or actions leading to professional growth. Teachers' professional development, on the other hand, is taken to refer to the broader changes that may take place over a longer period of time resulting in growth from acquisition of knowledge, skills, attitudes and broad qualitative shifts in aspects of teachers' professionalism. In the same vein Villegas-Reimers (2003:11) one of the experts in the field of teacher development, defined professional development as "development of a person in his or her professional roles" which leads to growth. The same author further states that professional development includes both formal and informal experiences. Attending professional meetings, workshops, and mentoring are considered formal experiences whereas reading professional publications or watching television documentaries related to academic

disciplines are considered informal. On the other hand, Darling-Hammond, Hyler and Gardner (2017) conceptualise professional learning as a product of both externally provided and job-embedded activities that increase teachers' knowledge and help them improve and change their instructional practice in ways that support student learning. Improvement and change suggest professional growth.

From the above definitions, common aspects that emerge from the different understandings of the concepts development and learning relate to processual aspect, acquisition of knowledge and skills, inclusion of both formal and non-formal aspects and focus on instructional improvement, hence, they are understood as enhancing teacher growth and change from knowledge acquisition. Consequently, in this study the two concepts are used interchangeably. Fraser et al. (2007) further point out that while the use of the term 'development' rather than 'learning' seems to depend on a somewhat arbitrary attribution of a broader, more general meaning to professional development and a more specific individual meaning to professional learning, these terms are often used interchangeably. Further to this, Garry Hoban (2002) and Fraser et al. (2007) concur that Bell and Gilbert (1996) have often used the terms 'professional development' and 'professional learning' interchangeably.

Bell and Gilbert (1994) in their theory indicate that teachers' professional learning is comprised of three aspects: the personal, social and occupational aspects which interact and are interwoven. The three aspects are reflected in Figure 3.3 below.

Figure 3.3: Bell and Gilbert's Aspects of Professional Development



Source: Researcher (2022)

Figure 3.3 above shows the interrelatedness of the three aspects of professional development as proposed by Bell and Gilbert (1994). Notwithstanding their interrelatedness, each aspect will be discussed separately for clarity and to highlight the multi-faceted nature of teacher development.

Personal Aspect

Bell and Gilbert (1996) assert that the impetus for change originates within the personal aspect of professional learning. Personal aspect of teacher learning and growth involves each individual teacher constructing, evaluating and accepting or rejecting the new socially constructed knowledge (Bell and Gilbert 1996) about what it means to be a Physical Sciences teacher (for example). In this study the Physical Sciences teachers would be expected to be evaluating their strengths and weaknesses related to their pedagogical practices (PK, PCK, SCK and other related classroom practices) as they reflect on and replay their lessons to be able to establish what they need to do to enhance their work and their professional growth. Drawing on and linking with the attribution theory (Weiner 2005) these personal aspects are internal attributions which the Physical Sciences teachers will be expected to construct, evaluate, accept and work on in order to professionally grow. In the face of challenges, the Physical Sciences teacher may find ways to solve the problems around their practices (using their internal attributions to change or impact the external factors). In the context of this study, the Physical Sciences teachers may improvise in the case of resource shortages and such innovations may reflect personal growth. What it means is that, teacher professional growth is determined by the teacher's individual interest, motivation, creativity, initiative and openness to learning (Guskey 2004).

Bell and Gilbert (1996) further indicate that the personal aspect of professional learning also involves managing the feelings associated with changing their activities and beliefs about the education system. On the personal level, Physical Sciences teachers from this study would be expected to engage in educational programmes and policies such as the Norms and Standards for Educators (NSE) (South Africa DoE 2005), the Continuing Professional Teacher Development (CPTD) developed by the South African Council for Educators (SACE) (DoE 2006) among others, as discussed in Chapter One, to enhance their professional growth within the personal aspect. Engaging in these programmes would help the teachers to change their negative perceptions and beliefs about Physical Sciences (and/or education in general) leading to professional growth and, consequently, teacher change. Further, a literature search (Lovett

and Gilmore 2013) consistent with Bell and Gilbert (1996) shows that teacher choice and control in determining engagement with learning opportunities was found to enhance professional growth. In this study, therefore, Physical Sciences teachers' internal attributions related to attitudes, beliefs and values may contribute to teachers' professional growth and play an important role in determining their self-efficacy which, in turn, contributes to teacher confidence. The social aspect also provides impetus for teacher professional learning and growth. I discuss this aspect below.

Social Aspect

Bell and Gilbert (1996) pointed out that professional growth in isolation is seen as problematic, and as such they suggest that there are social aspects which should support personal aspects of teacher development. For professional growth to occur, there must be a strong relationship between the individual and groups. They further indicate that communities of practice are advocated as one way forward in this regard. In this study, schools are the communities of practice for the Physical Sciences teachers where opportunities for collaboration with colleagues exist and interpretation of information and making meaning can result in mediation of new knowledge (Falk and Dierking 2000). To enhance their professional growth, Physical Sciences teachers may work in collaboration (networking) with other Physical Sciences teachers in their schools and at cluster level sharing some good classroom practices (PK, PCK, SCK etc). Working within a community reinforces shared beliefs and can contribute to the reconstruction of personal and professional identities (Bell and Gilbert 1996; Middlewood, Parker and Beere 2013) and such attributes enhance teacher growth and change. Teacher learning which is collaborative, active, social, contextual, engaging, and student-focused leads to deeper learning, development of higher-level thinking, oral communication, self-management, and leadership skills (Mukeredzi 2021).

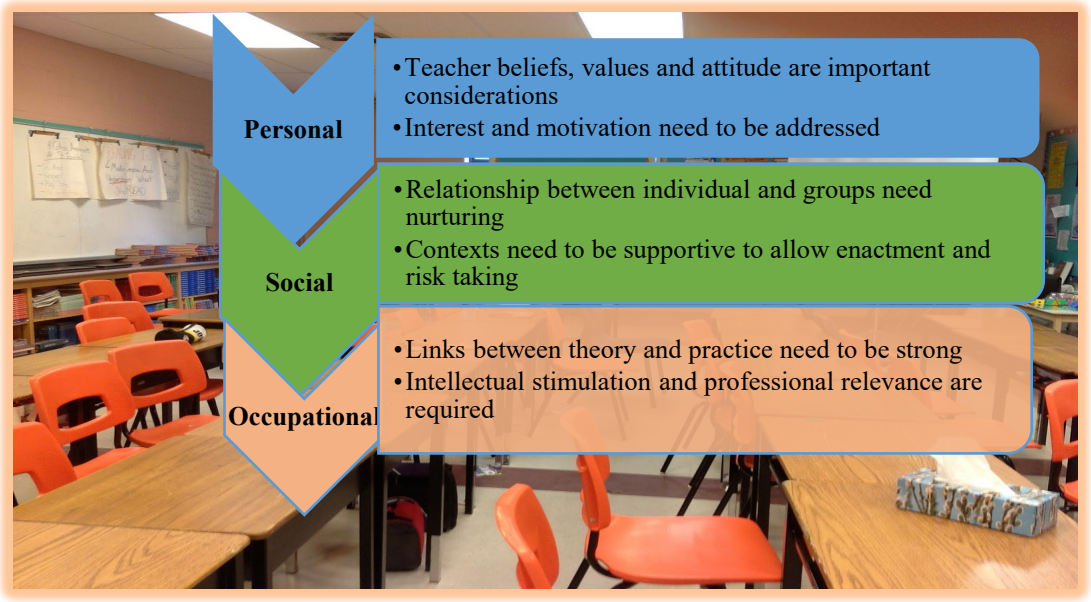
Bell and Gilbert (1996) further indicate that socially mediated learning occurs with other people perceived to be knowledgeable, such as facilitators or more experienced colleagues. Consequently, in the context of this study Physical Sciences teachers who attend annual orientation workshops at the beginning of each year and moderation workshops during the year would gain new knowledge which would enhance their professional growth. In such workshops matters related to classroom practice (handling learner diversity, assessment, and aspects around PK etc) would be discussed. In addition to being communities of practice and learning, schools in this study were situated within geographical and social contexts (rural, township and

urban) called the wider communities where socio-cultural expectations would also influence the enactment of teacher professional growth (Evans 2002). The next section discusses the third aspect of Bell and Gilbert – the occupational aspect of professional learning.

Occupational Aspect

Bell and Gilbert (1996) indicate that development of occupational aspects of teacher professional learning involve an interplay between theory and practice. Crucial to this process is an acceptance of theory which occurs most readily if the theory is based on credible, empirical evidence grounded in practice. In this study Physical Sciences teachers would probably professionally grow if they implemented the Department's professional growth initiatives such as the Quality Management System (QMS) (DBE 2022) and the Norms and Standards for Educators Act (NSE) (DoE 2005) with special emphasis on the seven roles for teachers. These initiatives designed for teacher development (outlined in Chapter One) if implemented in practice would probably enhance the Physical Sciences teachers' professional growth. Literature (Reeves and Forde 2004) consistent with the above also indicates that schools and classrooms provide rich environments for teachers to enact emerging learning within their own contexts. Such 'professional experimentation' might make teachers fully aware of learning actions and their consequences. If they can make meaning out of their practical experiences, particularly those with positive outcomes that would lead to growth, conceptual change and acceptance of the theory (Bell and Gilbert 1996). There would be an ongoing process of learning and development that involves cyclical inquiry, enabling multiple opportunities for these teachers (Physical Science teachers) to revisit their ideas and pedagogies and critically reflect on their implications, including what they would subsequently do differently in order to improve or uphold their good performance (Mukeredzi 2015). A summary of Bell and Gilbert's (1996) Aspects of Professional Learning is reflected in Figure 3.4.

Figure 3.4: Summary of Bell and Gilbert's Aspects of Professional Learning



Source: Researcher (2022)

Figure 3.4 above summarises Bell and Gilbert's (1994) Aspects of Professional Learning. Key elements for each aspect or domain of influence are reflected. As discussed above the three aspects are interconnected and all of them combined, provided a useful lens in interpreting data and answering Research Question Two on how attributions influence Physical Sciences teachers' professional growth.

The first stage of professional development would probably occur when Physical Sciences teachers begin to see an aspect of their teaching as problematic (personal) and practising in isolation as problematic and, therefore, seek to collaborate with colleagues (social), so that they may be motivated and assisted to find or try out new ideas in their pedagogical practices (occupational). As they progress in their professional growth, Physical Sciences teachers would probably deal with feelings and concerns that come about as they behave differently, for example, loss of control in classroom management, insecurity in PK, PCK or SCK, or uncertainty about how to intervene in learner discipline and begin to change their ideas of what it means to be a Physical Sciences teacher (personal). They would then probably begin to see the value of collaborative ways of working (social) and have confidence to develop their own ideas for classroom practice (occupational). Progressing further in their professional growth, these Physical Sciences teachers would feel empowered through increasing confidence

(personal). Further to this, they would then initiate or seek out collaboration (social) and eventually facilitate new kinds of professional learning activities.

Critique of Bell and Gilbert's Theory

Bell and Gilbert's (1996) personal dimension of professional learning has been received with criticism. Hargreaves (1992) argues that the personal aspect of professional learning has limited influence on teacher professional development. Drawing on Hargreaves (1992) what this suggests is that while being the only adult in a classroom can make the Physical Sciences teacher feel safe from negative criticisms and pressures to change, it does not provide the new ideas, support and feedback necessary for teacher growth.

Further, the personal aspect of professional development has been labelled as "Individualism" (Gergen 1991:8) and has been criticised as a social construct of Western Culture which may not be applicable in other contexts. In some non-western cultures, the group has a higher importance and the individual is seen only as a member of a group. In these cultures, one's relationships with others is more important than one's status as an individual. Consequently, professional development from the personal aspect is viewed as difficult.

However, notwithstanding the criticisms discussed above, adopting Bell and Gilbert's (1996) Aspects of Professional Development was vital for the current study. Firstly, while joining a teacher development programme (for example, clustering), involved taking some risks the expected benefits of working with other teachers to professionally learn and grow and improve teaching and learning were perceived as greater as compared to the personal aspect (individual focus on development).

Secondly, Bell and Gilbert's model portrays teacher professional learning as taking place in three intertwined domains, (personal, social and occupational) and identifies how progress occurs in each of these three domains. The fact that these domains are interconnected to influence teacher professional learning as a team, diminishes the weaknesses levelled against personal aspect.

Further to that, Bell and Gilbert's model arose from a study where teachers reconstructed their understanding of what it means to be a science teacher (Simon and Campbell 2012; Bell and Gilbert 1996) and this makes it more relevant to the current study which also focuses on how attributions influence Physical Sciences teachers' professional growth.

Lastly, the world is now a global village and people are now interconnected, consequently the issue of culture raised by Gergen (1991) (that personal aspect is not applicable to non-Western cultures) is likely to have changed given the time of his observation. Globalisation and human migration have probably diluted some cultures hence, the personal aspect of professional learning could have influenced the Physical Sciences teachers' professional growth. The next section provides a summary of the discussion on the theoretical framework.

Chapter Summary

This section explored the theoretical framework that informed the inquiry and guided data generation and analysis, namely, attribution theory (Weiner 2005) and Aspects of Professional Learning (Bell and Gilbert 1996). The attribution theory provided a lens for understanding the nature of Physical Sciences teacher attributions to their pedagogical practices. The historical development of attribution theory was discussed starting with its founder Fritz Heider (1958) who indicated that teacher behaviour may be attributed to internal or external factors. Kelley (1967), one of the proponents of attribution theory, through his ANOVA model reiterated that teacher behaviour is influenced by both internal and external causes. His model indicates that attributions are made based on three criteria: Consistency, Consensus and Distinctiveness (Kelley 1973).

Of all the attribution theorists, Weiner's (1971) model is widely used in classroom practice and hence a detailed discussion of this model was provided. Like his predecessors (Heider and Kelley) Weiner concurred that teacher attributions are based on internal and external factors. Weiner (1971) added the causal dimension to his model (locus of causality, stability and locus of control) to explain both the internal and external factors. Thus, drawing from this theory, Physical Sciences teacher attributions to their pedagogical practices may also be attributed to internal or external factors or both factors. A critique of the theory was also discussed including strategies to minimise the impact of the weaknesses on findings.

As an analytical tool, attribution theory was not completely helpful for analysing the influence of teacher attributions on professional growth. Consequently, Belly and Gilbert's (1996) Aspects of Professional Learning were adopted and discussed. The personal dimension of Professional Learning indicates that Physical Sciences teacher beliefs, values and attitudes are important elements. The social dimension emphasises the value of the relationship between the Physical Sciences teacher and other members in the teaching fraternity. In other words, collaboration (networking) is vital for professional development. With reference to the

occupational aspect, for professional learning to take shape, there must be a strong link between theory and practice.

Having discussed the theoretical framework, the following chapter discusses the methodology that was followed to find answers to the research questions.

CHAPTER FOUR

RESEARCH DESIGN AND METHODOLOGY

Introduction

The research sought to develop an in-depth understanding of Physical Sciences teacher attributions to their pedagogy and how they influence their professional growth. The previous chapter provided an overview of the theoretical framework adopted for the study. This study is informed by Weiner's (1986) attribution theory and Bell and Gilbert's Aspects of Professional Learning. Attributions as explained earlier are a person's perceived reasons that they give for a particular event (Weiner 1986). In this study, attributions are the explanations or reasons that teachers give for their or other people's actions, behaviour, feelings or beliefs, skills and knowledge that influence them to adopt particular teaching and learning experiences for learners. In other words, these are the basis for the teachers' classroom and pedagogical choices, decisions and actions. The complementary theory, Bell and Gilbert's (1996) Aspects of Professional Learning, provided guidance on the impetus for professional learning and growth. This theory holds that teacher professional learning is comprised of personal, social and occupational aspects which are inter-related. The two theories were vital in helping me understand, analyse and describe the nature of Physical Sciences teacher attributions and how these attributions shape their professional growth. In this chapter, I describe the research design and methodological approach adopted, explaining how I generated data to address the research questions set out in Chapter One.

The study was underpinned by one key question*: What is the nature of Physical Sciences teacher attributions to their pedagogical practices in UMzinyathi district and how do these attributions shape their professional growth?* This key question was addressed through the following two subsidiary questions:

1. What is the nature of Physical Sciences teacher attributions to their pedagogical practices in secondary schools?

2. In what ways do the Physical Sciences teacher attributions shape their professional growth?

In this chapter, firstly I discuss the research paradigm adopted for this study and the paradigmatic assumptions. Subsequent to this, the research design and qualitative approach are discussed. This is followed by a discussion on population and sampling procedures focusing on the purposive and convenience sampling techniques employed for extracting participants,

as well as the size of the sample that participated in the study. Thereafter, I discuss the research setting, followed by an outline of how I gained access to participants, followed by piloting. Subsequently, an outline of the data generation procedures and processes employed in this study – individual face-to-face interviews, document reviews and lesson observations – is discussed. There follows a step-by-step discussion of open coding data analysis employed in the study. Subsequently, I discuss the issues of rigour and trustworthiness focusing on the four criteria: credibility, transferability, dependability and conformability. I then outline the challenges that I encountered in the processes. I conclude the chapter with a discussion on ethical issues that were considered throughout the research, as well as limitations of the study. A chapter summary draws together the key issues discussed in the chapter.

Research Paradigms

A research paradigm is defined by Cohen, Manion and Morrison (2018) as a way of understanding the reality of the world. This world view encompasses a set of common beliefs and agreements shared between researchers about how problems should be understood, described and addressed (Kivunja and Kuyini 2017). Cohen, Manion and Morrison (2018) further assert that paradigms are viewed as ways of looking at the world, reflecting the different assumptions which researchers have about what the world is like, and how the world can be understood or known. A paradigm in this study is, therefore, the conceptual lens which guided me in selecting and determining the research design, approach and methods that I would use to find answers to my research questions and also to determine the data analysis procedure to be adopted (Kivunja and Kuyini 2017). The paradigm, thus, guided me in choosing appropriate methods for fieldwork and how to interpret and understand teacher attributions in rural, urban and township schools. In line with the above philosophical views, Mukeredzi (2009) points out that paradigms provide background information on the options and the beliefs that guide action taken in a disciplined inquiry or which point to what exists in relation to a phenomenon under investigation, including what and how it can be studied and understood. Thus, in this study, the paradigm guided me on philosophical orientations or beliefs that offered me a model or frame of reference, including assumptions that guided and helped me to determine and select methodological aspects, and appropriate research methods to find and report on the nature of Physical Sciences teacher attributions to their pedagogical practices and how these shaped their professional growth. Thus, a paradigm has important implications relating to decisions made in the research process (Kamal 2019), consequently, making it one of the key pillars of a research study.

Generally, there are three major paradigms: Positivist, Critical and Interpretivist.

The positivist paradigm relies heavily on experimentation (Kivunja and Kuyini 2017) and is known in research as a scientific method of investigation. A hypothesis is proposed, then it is either confirmed or rejected depending on the results of statistical analysis (quantitative approach). The positivist approach to analysing data is deductive (Cohen et al. 2018). Their objectivist epistemology asserts that human understanding is acquired through the application of reason (Kivunja and Kuyini 2017) and that reality is constant across time and setting, with only one truth that can be discovered. My study examined teacher attributions which involved behaviours, beliefs, opinions and emotions, thus, bringing in many truths, and I also did not intend to forward a hypothesis, consequently, the positivist paradigm was unsuitable.

With regard to the critical paradigm, the position of proponents is that a reality exists but has been shaped by cultural, political, ethnic, gender and religious factors which interact with each other to create a social system (Kivunja and Kuyini 2017). Thus, the critical paradigm deals with research for social justice and seeks to address the social, political and economic issues which lead to social oppression, struggle, conflict and power structures at whatever level these might occur (Kivunja and Kuyini 2017). Against this philosophical view, my study sought to explore teacher attributions and not social justice issues: as such the critical paradigm was also inappropriate for this study. As my study explored Physical Sciences teacher attributions to their pedagogical practices in secondary schools and how these attributions shaped their professional growth the interpretive paradigm which I discuss in detail below was appropriate.

Interpretivist Paradigm

Drawing on Kivunja and Kuyini (2017) interpretivists believe in socially constructed multiple realities and truths and that reality is created and not discovered. From this paradigm individuals interact with other individuals and society and ascribe meaning and names to different social phenomena (Cohen et al. 2018). The goal of interpretive research is not to discover universal context and value free knowledge and truth but to try to understand the interpretations of individuals of the social phenomena with which they interact (Grix 2014). In this study, I wanted to understand how the Physical Sciences teachers understood and interpreted their attributions, a social phenomenon. Interpretive methodology requires that social phenomena be understood through the eyes of the participants rather than those of the researcher (Kivunja and Kuyini (2017). Thus, viewing the phenomenon of the Physical Sciences teacher attributions to their pedagogy was understood from the understandings of the

participants – the teachers themselves, from their perspectives, subjective meanings and lived experiences – in other words, through the eyes of the participants. As pointed out earlier attributions represent explanations or reasoned justifications that people have for their or other people's actions or behaviour (Weiner 1986). In this study, therefore, the interpretive paradigm was appropriate as it looks beyond people's actions that can be observed in the context of a social occurrence and helps in understanding subjective meanings of the actions of the people studied (attributions) which are, in turn, interpreted to better understand the reasons for their actions (Mukeredzi 2016).

The interpretive paradigm also aligned with the theoretical framework adopted for this study (Weiner 2005) where teacher attributions deal with behaviours, perspectives, beliefs, opinions and emotions, which are subjective. The data generated were subjective as the researcher sought to generate deep understandings from participants as they engaged in face-to-face interviews. Literature consulted (Grix 2014) asserts that in the interpretive paradigm researchers are intimately part of the social reality being researched. In other words, the researcher is the main data generation instrument: as such they are not 'detached' from the participants they are studying. This suited well with my study since I was directly involved in the face-to-face interviews, lesson observations and document reviews.

Kivunja and Kuyini (2017) from literature surveyed further assert that the goal of interpretive methodology is to understand social phenomena in their context and data generated are mostly qualitative. The same source further contends that data are generated from participants over an extended period of time which in this study was consistent with the prolonged fieldwork (over four months) to accomplish in-depth two-series interviews (Seidman 1998) which I adopted. In addition, the interpretive paradigm, combined with the qualitative approach in which my study was located, is known for its extensive use of various forms of data generation instruments such as interviews, observations, filed notes, photo voice, collage, personal notes and documents that generate qualitative data to understand people's experiences and perceptions (Bertram and Christiansen 2020). This was the case in this study where I sought to explore Physical Sciences teacher attributions to their pedagogical practices through a multi-modal approach to data generation (face-to-face interviews, document reviews and lesson observations).

The interpretive paradigm was also appropriate for my study, in my quest for answers to my key question, as the supportive structure and framework to assumptions which guided me

through the research activities (Mukeredzi 2009). The philosophical assumptions were related to epistemological, ontological, axiological and methodological aspects. The interpretivist paradigm assumes a subjectivist epistemology, a relativist ontology, a naturalist methodology, and a balanced axiology (Kivunja and Kuyini 2017) and these are discussed below.

Epistemological Assumptions

Epistemology describes how we come to know the truth or reality of something or how we come to know what we know (Kivunja and Kuyini 2017) and what counts as knowledge within the world (Cooksey and McDonald 2011). The assumption of a subjectivist epistemology implies that as the researcher, I had to make meaning of the data generated related to teacher attributions through thinking and cognitive processing of the data, drawing on interactions with participants (Physical Sciences teachers). Epistemology, thus, focuses on the nature of human knowledge and comprehension that the researcher (knower) can possibly acquire from the knowable (researched), so as to be able to extend, broaden and deepen understanding in the field of research (Creswell 1998). In this study, the nature of human knowledge was the teacher attributions that I, as the researcher, had to explore from the participants perspectives in order to have a deeper understanding. Thus, the epistemological assumptions relate to how knowledge can be developed, created, and communicated. In other words, epistemology, represents the distance or relationship between the researcher and the researched with regard to data production (Mukeredzi 2009).

There are two epistemological views: Objectivism and Constructionism. Objectivism as a theory holds the view that knowledge is 'out there,' waiting for the researcher to obtain it (Creswell 1998). In this case there is some detached relationship between the researcher and the participant. Given the nature of my study, Physical Sciences teacher attributions to their pedagogy and how these shape their professional growth had to be understood through interaction, thereby minimising the distance between researcher and researched. In addition, as I had no prior knowledge of the nature of the Physical Sciences teacher attributions to their pedagogy, I adopted constructionism in this study as the epistemological stance. From the location of my research which adopted an interpretive framework, knowledge is a human construction based on lived experiences and perceptions of the research participants (Mukeredzi 2009). There was a close relationship between me, the researcher, and the researched – the Physical Sciences teachers. The distance between researcher and participants

was minimised through individual face-to-face interviews, lesson observations and document reviews in the process of data generation. Next, I discuss ontological assumptions.

Ontological Assumptions

Ontology is concerned with the assumptions that we make in order to believe that something makes sense or is real (Scotland 2012), the way the researcher defines the truth and reality (Antwi and Kasim 2015). In other words, it examines the underlying belief system of the researcher, about the nature of being and the nature of existence. Given the pedagogical activities that take place in classroom practice, it was my ontological assumption and belief that teacher attributions exist and it was the nature of these attributions that I wanted to understand and how they influenced the classroom pedagogical activities. These philosophical assumptions about the nature of reality are crucial to understanding how you make meaning of the data you generate (Antwi and Kasim 2015). In other words, how I, as the researcher, interpreted, made meaning or understood the data that I generated.

Creswell (1988) asserts that ontological assumptions make the researcher answer questions such as: Is there reality out there in the social world or is it a construction, created by one's own mind? What is the nature of reality? In other words, Is reality of an objective nature, or the result of individual cognition? What is the nature of the situation being studied? Positivists would respond to such ontological questions by referring to notions of reality being external, and objectively real, detached and being 'out there' in the world and awaiting acquisition (Mukeredzi 2009). Given the interpretive ontological stance in which this study was embedded, contrary to the positivist ontological view, reality or knowledge is socially constructed and subjectively experienced as it emanates from human cognition and is expressed through language (Mukeredzi 2009). Concomitantly, in this study, the ontological assumptions I had were subjective, socially constructed meanings, assuming that teachers as classroom practitioners had some attributions (based on beliefs, behaviours, opinions and emotions). Furthermore, given that teacher professional growth is a human creation which is experientially based and socially constructed by participants/actors (Physical Sciences teachers) in the research situation, consequently, the assumptions are subjective (Bignotti and Roux 2020). My study was automatically aligned to the social ontological outlook. The next section discusses axiological assumptions.

Axiological Assumptions

Axiology refers to the ethical issues that need to be considered when planning a research proposal (Kivunja and Kuyini 2017). It involves defining, evaluating and understanding concepts of right and wrong behaviour relating to the research (Antwi and Kasim 2015). In other words, axiological assumptions address all questions related to research ethics: human values and respect, participants' rights, moral issues, doing good and preventing harm, fairness, and minimising risk or harm to participants.

Axiological assumptions hold the view that the researcher should demonstrate best ethical conduct by showing an understanding of what is right or wrong behaviour during the research process (Creswell 1998). This consideration is founded on the premise that all humans have dignity which must be respected and they have a fundamental human right to make choices which a researcher must respect. During data generation and in all of my engagements with the research participants, every effort was made to remain open-minded, keeping quiet as they were talking and avoiding interference with their responses, taking them as they were because there were no wrong or right answers, allowing flexibility to deal with individual participants or observations thereby creating an environment conducive for in-depth data generation. Further, axiological assumptions encompass what my values are that I attribute to the different aspects of my study, the data, the participants, and the audience to which I report the results of the study. In Chapter One of this study I openly acknowledged and discussed my axiological assumptions (values) that may have influenced the data generation and interpretation.

Methodological Assumptions

Methodology is the broad term used to refer to the research design, methods, approaches and procedures used in an investigation that is well planned to find out something (Creswell 1998).

Kivunja and Kuyini (2017) state that methodological assumptions of a research include the research methods, strategies, techniques related to sampling, the size of the sample selected, as well as generation and analysis techniques for the data included in the research. Consequently, data generation, participants, instruments used, and data analysis are all parts of the broad field of methodology. Hence, in this study methodological assumptions were the procedures and processes that I followed to get an insider view of the Physical Sciences teacher attributions and how these shaped their professional growth. The phenomena of methodology and epistemology are interdependent in that methodology is a practical process (Mukeredzi 2009) which specifies how the researcher goes about studying what they believe can be known, while

epistemology is the theory of knowing (Makombe 2017). Thus, one is the philosophy of getting to know and the other is the practice of getting to know, with epistemology being the theory of knowing while methodology is the practice of knowing (Mukeredzi 2009). Methodology in my study, thus, refers to the specific methods and techniques (interviews, lesson observations and document reviews) that I employed for data generation to enable understanding of the phenomenon of Physical Sciences teacher attributions to their pedagogy. In sum, it was through the methodology that I was able to answer the main research question, through addressing questions about what I did, how I did it, when I did it, why I did it and with whom (Mukeredzi 2009), consequently contributing to knowledge. Having discussed the paradigmatic assumptions, the next section discusses the research design that I adopted for this study.

Research Design

A research design is the framework of research methods and techniques chosen by a researcher (Creswell 2014). MacMillan and Schumacher (2001) define it as a plan for selecting participants, research sites and data generation procedures to answer the research question(s). They further indicate that the goal of a sound research design is to provide results that are judged as credible. Thus, a research design serves as a strategic framework for action that serves as a bridge between research questions and the research execution. In other words, the research design sets the procedure on the required data, the methods to be applied to generate and analyse these data, and how all of this is going to answer the key research question (Grey 2014). In this study I adopted a case study design as it would enable data generation to answer the research question relating to Physical Sciences teacher attributions to their pedagogical practices from three different research contexts. Yin (2017) asserts that generally most case studies are qualitative in nature and qualitative research is characterised by an interpretative paradigm. This was the case in my study. As pointed out in the previous sections, my study is located in the interpretive paradigm and, consequently, such an alignment influenced my choice of research design. My study adopted a case study design as discussed below.

Case Study

Drawing from Yin (2017) a case study is a systematic and in-depth study of a particular case in one or more contexts. Case study research design enables a researcher to closely examine the data within specific contexts (Cohen et al. 2018). In most cases, in a case study design a small geographical area or small sample of participants in the study is selected (Creswell 2014). Therefore, in this study informed by Creswell (2014), this was a case of a small sample of

Grade 12 Physical Sciences teachers in one selected district (UMzinyathi) in KwaZulu-Natal province. Yin (1984) views the case study as an experiential inquiry that examines a contemporary phenomenon within its real-life context; when the boundaries between phenomenon and context are not clearly evident and in which multiple sources of evidence are used. These Grade 12 Physical Sciences teachers were studied in their local environment (schools) to discover and understand the phenomenon of teacher attributions in their natural setting. Adopting a case study was important for understanding different views of reality which I did by intensively investigating and exploring the phenomenon thoroughly and deeply. Specifically, my study adopted a multiple-site case study design which is discussed below.

Multiple-site Case Study Design

A multiple-site case study is a case study which contains more than a single case and whose evidence, therefore, is more convincing (Alpi and Evans 2019). Yin (2017) points out that a multiple-site case study investigates a contemporary phenomenon that exists in two or more real-world settings. In this study, a multiple-site case study was adopted as the study was conducted in three sites: rural, urban and township.

I employed the multiple-site case study where the case as highlighted above was Physical Sciences teacher attributions to their pedagogical practice and how they shape their professional growth. Yin (2009:42) points out multiple-site case studies present bounded systems, in other words, the cases can be separated out for research in terms of time, place or some physical boundaries which leads to a 'chain of evidence' from these aspects and functional interconnections of participants and their contexts. Merriam (2009) describes a bounded system as a single entity of focus, a unit around which there are no boundaries. In my study the boundedness related to the Physical Sciences (Grade 12) teachers in one particular district in KwaZulu-Natal. In other words, a particular group of individuals, Physical Sciences teachers, within the particular district. Stake (2005) further states that the boundedness of the case study is vital as it will guide the research questions and participant choices of the study. The rural, urban and township contexts in this study were investigated as separate, bounded systems. Although they were in one district, these sites were distinct with clear and known boundaries.

Informed by Creswell (2014), adopting a multiple-site case study allowed for robustness of research and comparisons within and across cases which enabled identification of similarities and differences between and within sites, thereby providing room for rich and unbiased data.

Yin (2018) and Brink (2018) in support of the multiple-site case study design assert that it aims to strengthen findings through wider exploration and replication of the research questions, as well as theoretical evolution which enables the researcher to understand the similarities and differences of data generated from various cases, in this case from urban, rural and township schools. Thus, the multiple-site case study design is viewed as stronger than the single-site case study due to the in-depth replications and comparisons. This case design was critical in my study as data from the three different sites promoted robustness and rigour (Creswell 2014) through data and contextual triangulation. Next, I discuss the research approach adopted for the study.

Research Approach

According to Creswell (2014), there are three main research approaches: quantitative, qualitative and mixed methods. Cohen, Manion and Morrison (2018) state that a research approach provides a strategy of action that directs the conduct of research systematically and efficiently. In this study, the approach guided the processes and procedures undertaken to generate and analyse data to answer research questions.

Quantitative research is a systematic process of collecting and analysing numerical data in order to test a hypothesis. Thus, quantitative research involves data that can be measured and counted. Creswell (2014) further asserts that the approach often involves a large sample and the use of surveys and questionnaires among others. My study, which was located in the interpretive paradigm which favours the qualitative approach and which did not intend to test any hypothesis (Kivunja and Kuyini 2017), did not suit the quantitative approach.

Mixed methods, developed by Creswell (2007), combines quantitative and qualitative approaches in addressing a research question. One of the outstanding strengths of the mixed methods approach is its increased validity in the findings, informing the generation of the second data set and assisting with knowledge creation (Creswell 2002). However, given the subjective philosophical and paradigmatic orientations and assumptions of my study, which required in-depth understanding of the Physical Sciences teacher attributions from their own perspectives, the mixed methods approach was not suitable. Again, as this study focused on attributions which deal with behaviours, beliefs, opinions and emotions, a qualitative approach was viewed as the most appropriate approach which allowed the researcher to explore ideas and experiences from participants' perspectives in depth. The next section gives a detailed discussion of the qualitative approach.

Qualitative Approach

Informed by the interpretive research paradigm adopted and the related assumptions, this study employed a qualitative approach. Creswell (2007) describes a qualitative approach as a systematic and subjective approach used to describe lived experiences and give them meaning, with the objective of exploring the depth, the richness and complexity of the phenomenon to gain deep insights. As the purpose of this study was to understand the lived experiences of the Physical Sciences teacher attributions to their pedagogy and how they shape their professional growth, this approach was appropriate. Furthermore, the qualitative approach was also preferred due to other characteristics that include the natural setting, the multi-modal quality and flexibility. These aspects are discussed below.

First, a qualitative approach emphasises data generation in natural settings (Yin 2017). Qualitative researchers generate data in the field at the site where participants experience the issue or problem under scrutiny or where the phenomenon happens. Cohen, Manion and Morrison (2018) state that qualitative researchers do not bring individuals into an artificial situation, nor do they typically send out instruments for individuals to complete. In this study, I generated data from the Physical Sciences teachers in their schools, this being their natural setting or environment where the phenomenon occurred. This was in line with the interpretive paradigm and case study design where researchers develop in-depth understanding of peoples' experiences in their natural setting (Yin 2017). This rich and unexpected data generated by actually talking directly to people and seeing them behave and act within their context was a major characteristic of qualitative approach which influenced my choice.

Secondly, a qualitative approach is known for its multi-modal quality in data generation techniques (multiple sources of data) which is interactive and humanistic (Yin 2017) and also enables methods triangulation. The value of the multi-method quality lies in the complementary nature of data generated through the chosen methods (Cohen, Manion and Morrison 2004). In this study, apart from enabling methods to filter one another as shortcomings of one are complemented by strengths of the other, this reduced method boundedness as employing multi-methods minimises exclusive reliance on one and gives a more complex picture of the reality under exploration (Mukeredzi 2009). This provides a multifaceted view of the phenomenon, however, not necessarily implying closeness to the truth. In this study, data were generated through multiple methods – face-to-face interviews, document reviews and lesson observations – rather than relying on a single data source. This data triangulation allowed me to review all

of the data, make sense of it and organise it into categories or themes that cut across all the sources, significantly increasing accuracy and trustworthiness. Low and Pandya (2019) assert that producing multi-modal transcripts may also lead researchers to feel that their data has been credibly and clearly mapped, with the component pieces all thoroughly accounted for. With regard to the humanistic nature of the qualitative approach, in this study I acknowledged and accounted for sensitivity and confidentiality of participants during the research process. Lastly, the qualitative approach allows a flexible data generation process to be constructed and reconstructed to a greater extent (Creswell 2014). This flexible nature of the qualitative approach enabled me to make amendments to the structure of my data generation process following Interview One. Interviewing 16 participants using in-depth two-series interviews (Seidman 1998) was not a smooth process. After each interview, I reflected on the steps followed and made any necessary adjustments before the next interview. Such modifications included the order of my interview questions, adjustments to interview times, as well as the pace at which the interview process was going. Flexibility also enabled me to adjust and reschedule appointment times in two cases where I found my participants attending meetings at their schools. The population from which my research sample was drawn and the sampling techniques employed to extract the sample are discussed in the next section.

Research Population

A research population is a well-defined collection of individuals or objects known to have one or more similar characteristics established by the researcher (Majid 2018). In other words, the population must meet a well-defined set of eligibility criteria for the purpose of a research study from which a sample can be accurately identified. In this study, the population comprised 114 secondary schools offering Physical Sciences in UMzinyathi district of KwaZulu-Natal Province. Thus, the common characteristics shared were that all the teachers were teaching Physical Sciences, in Grade 12 and in the same district. The Physical Sciences teachers, who constituted the population, were identified at rural schools, urban schools and township schools. It is from this population that I extracted a sample for study and from which the results of my research would be derived. Next, I discuss sampling techniques employed and the sample.

Sampling Techniques and Sample

According to Creswell (2014) a sample is a representation of the population of interest which is large enough to answer the research question(s). Simply put, a sample refers to selected

individuals who represent a population of the study, a group large enough to adequately provide answers to the key question. Furthermore, Cohen, Manion and Morrison (2017) point out that the sample from the population where it is drawn must be a good size to warrant analysis (Cohen, Manion and Morrison 2017). Given that this is a qualitative study which works with small samples to generate in-depth subjective data (Cohen, Manion and Morrison 2017), a minimum sample size of 16 was deemed adequate for analysis in my study. Moreover, a minimum sample size of 16 was regarded as an adequate sample size for data saturation (Francis et al. 2010). Data saturation implies that data should be collected until there are fewer surprises in the data and no more new patterns or themes are emerging therefrom (O' Reilly and Parker 2013). Francis et al. (2010) assert that data saturation occurs more or less after 13 to 15 interviews. Drawing from the above I, therefore, considered a minimum sample size of 16 as appropriate and adequate in this study.

This study adopted two sampling techniques to select the schools and 16 study participants: convenience sampling and purposive sampling. These are discussed in turn below.

Convenience Sampling

Convenience sampling is a non-probability sampling design which involves selecting members of the target population that meet certain practical criteria, such as easy accessibility, geographical proximity or availability at a given time (Cohen, Manion and Morrison 2018; Rafail 2017). I used convenience sampling to identify 16 accessible secondary schools from the three sites: deep rural areas, township and urban settings in UMzinyathi district. These schools were easily accessible in terms of distance and geographical locations with a radius of approximately 130 km from where I was teaching. As I was based in the same district with the participants it was convenient, fast and cheaper to access them. After conveniently sampling the 16 schools from the district, I had to employ the purposive sampling technique to extract the Physical Sciences teachers. I discuss purposive sampling in the next section.

Purposive Sampling

According to Tailor (2005) purposive sampling, a non-probability sampling technique, is a deliberate choice of a participant due to the knowledge qualities the participant possesses. Thus, the purposive sample was selected based on their knowledge of the phenomenon under scrutiny. Cohen, Manion and Morrison (2018) state that participants have to be knowledgeable people who have in-depth understanding about the phenomenon under study by virtue of being professional, experienced or experts. In this study, therefore, I employed purposive sampling

to extract the Physical Sciences teachers who were proficient and well-informed of the phenomenon of interest (Physical Sciences). The sampled teachers were those teaching Physical Sciences in Grade 12 in the 16 rural, urban and township secondary schools selected. I sampled out only one teacher per school. In all except three of the sampled schools, there was one Physical Sciences teacher chosen but in the three there was more than one teacher teaching the subject. In such a scenario sampling was based on years of experience (which I gathered from their Principals) as the inclusion/exclusion criterion. Cohen, Manion and Morrison (2018) state that inclusion criteria should specify an attribute that cases must possess to qualify for the study while exclusion criteria must stipulate attributes that disqualify a case from the study. In my study the inclusion criteria was that the teacher must be teaching Grade 12 and automatically those teaching lower grades only were excluded. In the case of more teachers teaching Grade 12, I sampled the one with more years of teaching experience in the subject. Inclusion of a participant with more experience in the teaching field was informed by Mukeredzi (2009) who asserts that the researcher must extract participants who are deemed information-rich. Thus, given the more years of teaching, I assumed that such teachers would be information-rich.

UMzinyathi district, which is the site of this study located in Kwazulu-Natal province, had a population which was predominantly rural (93%) and urban (7%) (STATS SA 2016) and consequently the bigger sample (eight) for this study was from the rural site. I then selected four participants each, from the urban and township contexts (schools). Selecting from different contexts was vital for comparisons. Table 4.1 below reflects the number of participants sampled from each context as highlighted above.

Table 4.1: Number of Research Participants per Context

Rural context	Urban context	Township context	Total number from all contexts
8	4	4	**16**

As illustrated above the sample size for my study was 16 Physical Sciences teachers drawn from three sites (Rural, urban and township) which consequently gave rise to the multiple-site case study design highlighted above. The next section describes the research setting: the three contexts (rural, township and urban) from where data were generated, analysed and explained.

Research Setting

As alluded to in the previous sections, this study which explored Physical Sciences teacher attributions to their pedagogical practices was located in UMzinyathi District in KwaZulu-Natal province. UMzinyathi district the site of this study is predominantly rural (Nqutu and Msinga Municipalities), with relatively small urban areas (Dundee in Endumeni and Greytown in Umvoti Municipalities) (STATS SA 2016). This section describes the research setting to offer a clear understanding of the context in which data were generated, analysed and explained. The physical locations of these areas are indicated in the map below.

Figure 4.1 Location of UMzinyathi District in KwaZulu-Natal Province in South Africa

Source: Google search www.umzinyathi district (2022)

Rural Setting

The South African Schools Act (SASA) (1996) (Act 84 of 1996) provides for two types of schools: public and independent schools. There were eight rural schools which participated in this study as indicated in Table 4.1 above. All of these were public schools under Section 21 where learners did not pay school fees. The schools were generally not well kept: some had broken windows, others had classrooms without doors and the environments were generally untidy with widespread litter. Mukeredzi (2021) laments that some rural schools are dilapidated to an extent that the picture portrayed is not enticing for those considering a teaching career or to earn a living there. In three of these schools, the atmosphere was generally lackadaisical – not business-like – as learners loitered outside during learning time when they should have been in classrooms. There was generally a shortage of learning venues evidenced by overcrowded classrooms in four schools where Grade 12 classes had 60-65 learners. Teachers at such schools expressed frustration with these abnormal classes. For example, Teacher 3 Rural during Lesson Observation commented that:

You see Meneer (Mr/sir), our classes are very big and its difficulty to have a one-on-one interaction with learners…when it comes to marking its hectic but we have no choice.

The issue of overcrowding in South African Schools was highlighted by Marais (2016) who indicated that overcrowded classrooms are unfortunately part of South African education and will remain a part of the immediate future and even the long-term future. Such situations have negatively affected teacher professional growth.

Four rural schools which participated in this study were small, with enrolments ranging from 150 to 350 learners and a staff complement of between seven and twelve teachers including principals. Some teachers were teaching two to three subjects per grade. This scenario is consistent with Mukeredzi (2021) who states that many rural schools in South Africa have multiple grade/multiple subject teaching assignments. Schools were generally far spaced: approximately 30 to 40 kilometres. Consequently, some learners walked more than an hour to get to school. Fortunately, for one of the schools, the DBE later provided a bus to transport learners who were far away from the school.

Teaching and learning resources were in short supply and teachers struggled to deliver effective lessons. UMzinyathi district is one of the poorest and least developed South African rural communities that are located in the former homelands and conditions of poverty and underdevelopment in these settings continue to be reflected by poor quality education available

there and evident deficiencies related to limited infrastructure and basic facilities in these rural schools (Gardiner 2008). Nkambule et al. (2011) assert that not much has changed in the rural education environment as the rate of educational progress in these former homelands has remained limited. This was further noted by Mukeredzi (2021), who asserts that electricity and piped water were non-existent in these schools: they depended on boreholes or rainwater harvesting. During dry seasons, councillors, parents and School Governing Bodies (SGBs) ferried water to the schools. In some schools, there were no flush toilets and children still used pit latrines. Masinire (2015) contends that the shortage of resources such as textbooks, classroom space and professional support not only negatively affects the professional image of rural teachers but also their professional learning and growth.

Moreover, in all the eight rural schools studied, there was no science laboratory: instead, teachers had Science kits some of which had incomplete apparatus. Hugo et al. (2010) in a report to KZN Provincial Treasury reported that many public secondary schools in South Africa, particularly in rural areas, lack proper laboratory facilities, thus learning of Physical Sciences was and probably is still difficult for learners. As a result, Physical Sciences remained at a very theoretical level without any experiments to enhance the understanding and application of knowledge. Teachers in the rural schools studied lived in nearby townships and shared transport to and from schools, which created opportunities for knowledge sharing and professional growth.

Township Setting

The four township schools used in this study were under Section 20 where learners paid school fees, unlike the rural schools that were in Section 21 where children did not pay fees. Generally, these Township Schools were located approximately 35 kilometres from the urban areas. The schools had adequate physical and material resources, enough learning and office space, as well as teaching and learning materials including science laboratories. This promoted teacher professional learning and growth. Some of the schools had running water and electricity, unlike the rural schools where there was no running water. While the rural schools were small (150 to 350 learners), township schools were bigger with enrolments of between 500 and 800 learners and an average staff complement of 23 teachers.

The schools' catchment areas were close, so children did not walk long distances to school like the rural children. Teachers lived in the townships where the schools were situated which resulted in minimal travelling, consequently enabling them to arrive at schools early and to

leave late. Having more time at school preparing and planning for their daily classroom work and marking created opportunities for professional growth unlike their rural counterparts who used more time commuting to and from work. Most of the parents in township communities valued their children's education and so supported school activities. Mukeredzi and Manwa (2019) indicate that good school-parent relations and support are effective in fostering teacher professional growth experiences, classroom practice and control, as well as learner discipline. Unlike rural school environments, township schools portrayed a clean outlook as they were well-maintained and kept clean and tidy by the Community Works Programme (CWP), which was not the case in the rural schools investigated.

Urban Setting

As indicated in Table 4.1 above, four Physical Sciences teachers at urban schools were involved in this study and these schools were under the public governance and also under Section 21 where all learners paid school fees like those in township schools. These urban schools were all well-resourced and had adequate facilities, as well as learning and teaching materials including science laboratories, libraries and extra-curricular facilities. The schools were large and enrolments were quite high, ranging from 650 to 800 learners, slightly higher than in the selected township schools. The staff complement was between 20 and 25 and most teachers were teaching only one subject in the phase (for example Physical Sciences from Grade 10 to 12 FET phase – Further Education and Training). All schools offered education from General Education and Training (GET) (Grade 8-9) to FET (Grade10-12). Teaching one subject in the same phase allowed for a deeper Subject Content Knowledge (SCK) and Subject Pedagogical Knowledge (SPK) which enhanced teacher professional growth, a sharp contrast to the rural setting in this study. Moreover, contrary to the rural schools studied, all four urban schools in this study had well-equipped laboratories for laboratory work. In two of the urban schools, the teachers were using overhead projectors in lesson delivery. The availability of such resources in the teaching of Physical Sciences enhanced teacher professional growth given that the subject has a practical orientation.

Urban schools held regular staff development workshops and meetings which supported teacher professional growth. Parents were supportive of the schools which enhanced teacher professional growth through parents-teacher discussions, like in the township schools, an aspect which was lacking in the rural setting. The differences noted above are in line with literature sourced (Jackson 2009) which states that teaching from around the globe is

characterised by great unevenness with dramatic differences in resources and even teacher quality within regions, within communities and even within schools. Next, I discuss how I accessed participants.

Gaining Access to Research Participants

Morrison (2011) from consulted literature points out that the first stage in research involves gaining official permission to undertake one's research within the target community. Therefore, as a researcher, it was necessary to get permission from the gatekeepers to carry out the study. Thus, for this study, I first received permission from the South African Department of Basic Education (DBE) on 14 February 2018 (Appendix Three) which I submitted to the University in applying for Ethical Clearance. The Ethical Clearance was granted by the Institutional Research and Ethics Committee (IREC) of the Durban University of Technology (DUT) (Appendix Two) on 29 August 2018. Having been granted permission by the DBE, and DUT IREC, I went to the District Office (DO) (UMzinyathi) where I was given consent after producing DBE letter and DUT Ethical Clearance. I was then requested to leave a copy of the permission letter from DBE for their records. The process of unlocking gates and gaining consent is emphasised by McMillan and Schumacher (2006) who assert that, when conducting research in an institution like a school, approval for conducting the research should be obtained from the institution, as well as from responsible authorities, gatekeepers and the participants.

After getting permission from the DBE it was vital to undertake preliminary visits to the schools to meet the principals, introduce myself and the purpose of the study and obtain their (the principals) consent. This was also an opportunity to clearly explain what I would request of the teachers. During this preliminary visit, I also met the teachers to request their participation and obtain their consent. While the process was generally smooth, one Principal agreed but gave me conditions:

> *You can go ahead sir with your research but make sure that when you come, you don't disturb the teaching and learning and also when you do your lesson observations please arrive on time* (Principal 2 Urban).

Comments such as these made me reflect on my appointment schedules and prepared me to expect different receptions from the different schools. Moreover, one "would-be participant" at one of the rural schools I had purposively sampled declined to participate when I explained to her that I would audio record the interviews. I felt that the focus and nature of my study required willing and keen participants who would freely share to a profound degree their

experiences and opinions (Mukeredzi 2009). Therefore, I had to be certain that all the Physical Sciences teachers that I recruited had the inherent desire and commitment to participate.

Consent was obtained after I explained the research process to the participants, going through the information letter (Appendix Seven) together and explaining up-front that the University's IREC and DBE had given me permission. The consent form was completed and signed by the participants (Appendix Nine). I also highlighted to the participants that they were free to contact the University's IREC and my supervisors if they suspected any unethical behaviour on my part as a researcher. I further emphasised that they were free to withdraw at any time as stated in the consent form without any prejudice to them. It was through such open and frank engagements that they consented to participate and thereafter we exchanged personal and contact details. Such familiarisation enhanced bonding and mutual trust. Next, I discuss the pilot study.

Pilot Study

Prior to the main data generation process I carried out a pilot study. A pilot study is a small-scale research project conducted before the final full-scale study (Ismail, Kinchin and Edwards 2018). Informed by Yin (2017) this small study was meant to test the appropriateness of my data generation tools, check time requirements, identify the questions which would generate similar responses, assess whether the data generated would answer the research questions and detect any potential problem areas and deficiencies and then decide on how best to conduct the final research study. The data generation tools to pilot test were the face-to-face interview schedule, lesson observation and document review check list. The pilot sample comprised of two Physical Sciences teachers from the rural context and one each from urban and township contexts making a total of 4 participants. Getting to these schools I asked for permission from the principal, following the same process as outlined in the section on accessing participants explained above. However, the pilot study participants were not included in the main data generation process of the study. Morrison (2015) points out that the benefits of piloting the interview questions is to provide an opportunity to see them in practice and to judge their suitability, to determine whether any questions were too ambiguous or complicated and also to get feedback from the participants. During piloting I discovered that my lesson observation and document reviews check lists had some gaps. I then modified with the guidance of my supervisor. Having rectified all the errors in my data generation instruments, I was ready for the main data generation process which is discussed in the next section.

Data Generation

As informed by Creswell (2014), I carried out data generation in the participants' natural settings (schools) where the participants experienced the phenomenon under study (teacher attributions to their pedagogical practices). Face-to-face interviews, document reviews and lesson observations were the data generation instruments as illustrated in Table 4.2 below.

Table 4.2: **The summary of Data Generation for the Study**

	Rural context		Urban context	Township context	Total
Interview 1	8		4	4	16
Interviews 2	8		4	4	16
Lesson observations	2		2	2	6
Document reviews	2		2	2	6
Total	**20**		**12**	**12**	**44**

Data generation was carried out from 3rd September 2018 to 11th February 2019, as reflected in Table 4.3 below. The dates I was involved with each participant per instrument are also indicated.

Table 4.3 Data Generation Itinerary

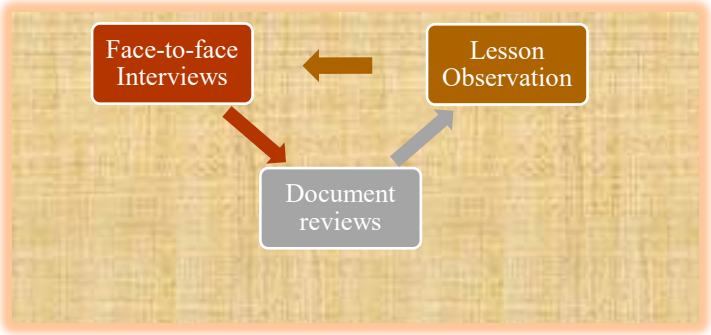
Context	Participant Code	Dates for Face-to-Face Interview 1	Dates for Face-to-Face Interview 2	Dates for Document Reviews	Dates for lesson observation
Rural	Teacher 1 Rural	3 September 2018	6 November 2018		
	Teacher 2 Rural	10 September 2018	8 November 2018		
	Teacher 3 Rural	16 October 2018	15 November 2018	21 January 2019	10 January 2019
	Teacher 4 Rural	4 September 2018	23 October 2018		
	Teacher 5 Rural	10 October 2018	13 November 2018		
	Teacher 6 Rural	13 September 2018	20 November 2018		
	Teacher 7 Rural	13 September 2018	20 November 2018		
	Teacher 8 Rural	10 October 2018	23 November 2018	18 January 2019	25 January 2019
Urban	Teacher1 Urban	21 September 2018	14 November 2018		
	Teacher 2 Urban	21 September 2018	14 November 2018	1 February 2019	11 February 2019
	Teacher3 Urban	12 October 2018	19 November 2018	4 February 2019	9 February 2019
	Teacher4 Urban	15 October 2018	19 November 2018		
Township	Teacher 1 Township	2 October 2018	30 November 2018	6 February 2019	11 February 2019
	Teacher 2 Township	8 October 2018	30 November 2018	18 January 2019	25 January 2019
	Teacher 3 Township	28 September 2018	2 November 2018		
	Teacher 4 Township	19 October 2018	2 November 2018		
3 Contexts	**16 Participants**	**16 Face-to–face Interview One**	**16 Face-to–face Interview Two**	**6 Document reviews**	**6 Lesson observations**

All research participants were allocated codes according to their contexts, for example, Teacher 1 Rural to Teacher 8 Rural; Teacher 1 Urban to Teacher 4 Urban; and Teacher 1 Township to Teacher 4 Township. I did this to ensure anonymity. The same codes were used in all data presentation and analysis chapters.

I started the data generation with face-to-face interviews. This was followed by document reviews and finally lesson observations. I started with face-to-face interviews as informed by Goldkuhl (2019) who asserts the interaction between the researcher and the participant during interviews creates a fertile ground for future engagements between the two. Once a mutual understanding was hatched it became easier to go through documents and lesson observations. According to Goldkuhl (2019), the participants feel free if they have had previous engagements with the observer. As for the other two instruments, I completed document reviews first and subsequently carried out lesson observations on different days. This was to allow for critical

reflections on the document reviews making connections with the interviews that had been held previously before lesson observations. Reflection was critical for learning during this process to ensure addressing any necessary modifications (Mukeredzi 2015). In addition, conducting document reviews before lesson observations helped me to take note of aspects to look out for during the lesson and also to compare their planning and practice, thereby identifying attributions. Figure 4.2 below illustrates the data generation methods adopted in this study.

Figure 4.2 Data Generation Methods



Source: Researcher 2022

The data generation process using the three research techniques is discussed separately below.

Face-to-face Interviews

The study adopted a two series interview approach (Seidman 1998) where I held two separate interviews with each of the selected 16 Physical Sciences teachers. Seidman (1998) and Mukeredzi (2013) concur that interview data should involve more than a single interview for richer qualitative data. The two-series interview enabled participants to reflect on what they said, creating potential for more reflection in the second interview (Seidman 1998). Thus, adopting this approach helped the Physical Sciences teachers to think back and replay what they said during the previous interview which enabled them to give more data in the next interview, thereby enhancing in-depth data generation. The approach also gave me time to reflect on my interview style and to refine it (Seidman 1998).

Creswell (2010) asserts that an interview is a two-way conversation in which the interviewer asks the participant questions to collect and to learn about the ideas, beliefs, views, opinions and behaviours of the participants. In this study, I met individual participants and asked them questions about their views, beliefs and experiences related to the teaching of Physical Sciences. Creswell (2010) adds that interviews are flexible and when the participant indicates

that she/he has not understood the question, the researcher can repeat and probe for more specific answers. Capitalising on the flexibility of interviews, I was able to clarify and explain some of the questions where it was necessary and this enabled me to get elaborations on responses, where they were initially inadequate or unclear, thereby enriching the data generated.

Interviews were guided by an interview schedule (Appendix One) with semi-structured questions which helped me to maintain a similar sequence across all participants and to keep me focused within the parameters of the study. Literature surveyed (Korstjens and Moser 2017) suggests that a pre-planned, semi-structured interview guide helps the researcher to be in control of and to give direction to the interview, while the participants are in control of their answers. I conducted two individual face-to-face interviews with all 16 participants from the three contexts (8 Rural, 4 Urban and 4 Township) making a total of 32 face-to-face interviews. These individual face-to-face interviews took approximately 45 to 60 minutes each. The interviews were audio recorded to capture the interview responses accurately and this allowed me to attend to the interviewee and probe all questions rather than focus on writing brief notes. Drawing on Mukeredzi (2009), dependence on participants' words and voices is a typical feature of qualitative enquiry, therefore, tape recordings produce complete verbal transcripts as they allow capturing of every detail. Thus, in addition to enabling me to make sparse notes, I was able to attend fully to the interviewee and uphold the flow of conversation.

In preparation for the interviews, I called the participants two or three days before, reminding them of the schedule and confirming my visit to their schools. The confirmation from the participants gave me assurance that the interview was going to take place and that thorough preparations had to be done for the process.

Interview One was meant to set the context for the participants' attributions where they talked about their teaching history which led them to talk about their attributions. Interview Two was based on a particular teaching day where teachers reconstructed the details of what they actually did, how, when and with whom, which enabled them to describe and critically reflect on how these attributions shaped their professional growth.

During the face-to-face interviews, I adopted an open and emotionally neutral body language in order to allow the participants to contemplate their responses, talk more and elaborate on and clarify issues while I nodded showing my genuine interest in what they were saying. Informed by Mukeredzi (2016), I practised good listening skills: keeping quiet when

participants were talking and demonstrating that I was listening from my facial expressions and verbal sounds ("Mmm hmm", nodding my head), sometimes repeating what they said word-for-word, for example, "What you're saying is...". This enabled creating an atmosphere conducive to participant engagement with the process and with the researcher (Mukeredzi 2016) and encouraged the Physical Sciences teachers to keep talking, thereby offering more rich data. I probed further and followed up on questions to gain in-depth insight about how these teacher attributions shaped their professional growth as informed by Hawkins (2018).

Fox (2009) states that if the researcher is conducting more than one interview, he/she must try to make a regular arrangement and typically not leave gaps of more than a week between interviews. On the contrary, Seidman (1998) advises that for series interviews, the researcher should allow at least two weeks to allow for reflection and internal consistency. Seidman (2015) further argues that spacing of interviews depends on the structure and processes of the study, to allow participants to reconstruct and reflect upon their experiences within their contexts. Thus, in this study, interviews were held within four to six weeks of each other. This was intended to confirm internal consistency of participants' stories (Mukeredzi 2009) and also facilitated comparisons and connections of experiences of different respondents. Firstly, further to this, my data generation process started towards the end of the year. All teachers were busy preparing learners for trial examinations and they suggested dates when they would be free. Secondly, my participants were dispersed, particularly in rural schools, hence I needed to allow adequate time for the process thereby automatically adopting Seidman's (2015) advice.

One of the weaknesses of the face-to-face interview method noted by Yaya (2014) in the literature surveyed is insecurity on the part of respondents. Interviewees tend to feel intimidated and insecure which may inhibit production of rich data (Adoukonou 2019). However, in this study I made every effort to ensure that the participants felt comfortable and relaxed and employed approaches that made them continue talking. I allowed the participants to adjust or reschedule the interview times in order to avoid interfering with their teaching and putting them under pressure. Interviews were held in Departmental Heads' offices, empty classrooms away from learners and other teachers and, in some cases, in storerooms located in Science laboratories where it was quiet and confidential. In surveyed literature, Kumar (2018) argues that interviews are time-overwhelming and difficult to administer. However, in this study first we had mock interviews at university where we practised using our questions. Second, I planned thoroughly after effecting piloting amendments. Third, I rehearsed my questions particularly for the first interview, and fourth, I followed the schedule strictly except where I

had to probe and follow up on questions. Before winding up each interview, I would go through the main points so that participants could verify their responses, thereby cultivating trust in the process and doing preliminary member-checking.

Document Reviews

After conducting face-to-face interviews, it was necessary to do document reviews, which sequence helped me to determine consistence of the responses therefrom. Adopting document reviews as a data generation technique is informed by the notion that professional growth can be understood against some legitimate framework (Mukeredzi 2009). Bowen (2009) describes document review as a form of qualitative research in which documents are interpreted by the researcher to give voice and meaning around a research phenomenon. Therefore, in this study document reviews generally included: Curriculum Assessment Policy Statements (CAPS) document; Annual Teaching Plans (ATP); Programme of Assessment (POA); lesson plans; records of marks; learners' exercise books; and, in some cases, individual learner progress records. Other physical artefacts reviewed included apparatus used in the laboratory and the science kits. I made a total of six document reviews, that is, two from each of the three contexts as indicated in Table 4.2. In selecting the participants for document reviews, from the sample of 16 Physical Sciences teachers, I selected six participants who had the most experience. I used experience criteria, (purposive sampling: the highest number of years in the field) with the aim of generating in-depth data.

One of the advantages of adopting document reviews as a data generation strategy is that documents are an accessible and reliable source of data (Owen 2014). Moreover, as I had 32 face-to-face interviews and 6 lesson observations, analysing documents was far more cost and time efficient (Bowen 2009). In support of the above view, Yin (1994) asserts that document review as a research method is particularly applicable to qualitative case studies and all types can help the researcher uncover meaning, develop understanding and discover insights relevant to the research problem. In this study, therefore, documents that I reviewed were important for understanding the nature of Physical Sciences teacher attributions to their pedagogical practices.

The reviews were guided by a semi-structured document review rubric (Appendix One) as informed by Bowen (2009). Comments in learners' exercise books such as "keep it up", "work hard", "avoid laziness" and "be serious with your school work" helped me to understand teachers' beliefs, feelings and emotions which are the basis of teacher external attributions.

Drawing from O'Leary (2014) the frequency and volume of occurrences of a comment within the document can be used to make conclusions on a participant's views, beliefs and feelings. Approximately, document reviews took 40 to 60 minutes each.

However, Yin (1994) notes some concern regarding document reviews arguing that documents were not created with data research agendas and, therefore, require some investigative skills. Yin (1994) further states that documents will not perfectly provide all of the necessary information required to answer the research questions. To overcome this in my study, I was very careful on the choice of documents to be reviewed and the semi-structured rubric that I used was crafted in such a way that I focused only on matters that answered my research question (Research Question One: the nature of Physical Sciences teacher attributions to their pedagogical practices) such as the learner activities as indicated in the lesson plans, teachers' comments in learners' exercise books, record of marks and the type of apparatus used in experiments I did this as informed by O'Leary (2014) who asserts that some documents may only provide a small amount of useful data or sometimes none at all. The next section discusses lesson observation as a data generation approach as shown in Figure 4.1.

Lesson Observation

After conducting face-to-face interviews and document reviews, I revisited each of the participants whose documents I had reviewed to carry out non-participant lesson observation guided by a semi-structured observation checklist (Appendix One). Assarroudi et al. (2018) define non-participant observation as a data generation technique which involves observing the research participants without actively participating. The observations were done when the teachers were conducting Physical Sciences lessons at their schools. They were holistic observations where I was checking all aspects of classroom practice (aspects such as lesson delivery, learner activities, teacher-learner interaction, learner-learner interaction, learner-teacher interaction, classroom management, teacher handling of questions and responses, and listening to the teacher's comments). It was from these teacher classroom moves that I was able to identify their attributions to their pedagogical practices. I made six lesson observations, two observations in each of the three contexts. In this study, as the objective was to understand the nature of Physical Sciences teacher attributions, the main focus during the observations was the participant and how they fostered some of the classroom actions cited above.

While observations were generally approximately 50 to 60 minutes, duration varied from school to school as I had to fit into the school timetable. This was in line with Goldkuhl (2019:

582) who asserts that: “An observation study means that researchers perceive on-going processes in a natural setting … not interfering with the humans that they observe.” In about three cases where the participants were teaching more than one class in Grade 12 (for example Grade 12 A and B) I waited for a second observation to obtain more data and verify consistence.

The strength of the observation is that the researcher will not only hear what the participants are saying but has an opportunity to see and feel as they interrelate with the participants (Assarroudi et al. 2018). The use of non-participant observation in this study provided an opportunity to get a more objective view of the Physical Sciences teacher attributions to their pedagogical practices as this enabled me to acquire data that the participants were probably unable to express verbally.

However, Creswell (2014) asserts that one of the weaknesses of lesson observation is that participants may stage manage to please the observer. Therefore, since participants were knowledgeable about my presence during the observation sessions, there were chances that they probably behaved differently. However, to address this weakness, I did lesson observations right at the end after face-to-face interviews and document reviews. It would have been difficult for the participants to stage manage as we had developed rapport, familiarity and bonding from engagements during the other two data generation techniques, coupled with frequent confirmation phone calls.

Member Checking

I asked participants to ‘member check’ Interview One transcripts after Interview Two, given that I had a two-interview series approach. At the end of the second interview, I gave each participant an opportunity to check their transcript and verify the accuracy of data capturing. In addition, at the conclusion to each of the interviews, I would go through the main points raised and ask the participant to confirm, add or subtract. All this enhanced study credibility and eliminated researcher bias (Creswell 2012). I gave the participants time to refresh and thereafter engaged in member checking of transcribed and printed scripts. All 16 participants member checked transcripts for Interview One and 13 member checked Interview Two transcripts as well. For those involved in document reviews and lesson observations, I asked them to member check transcripts of Interview Two after lesson observations. I also visited and asked other participants (7) in urban and township schools to member check Interview Two transcripts at the end of all data generation. I was not able to engage all the 16 participants in member checking transcripts of the second interview. Thus, member checking was done by 13

out of 16 participants. Informed by Yin (2014) who views member checking as a process in which the researcher asks one or some of the participants in the study to check the accuracy of the transcriptions, I felt that the member checking done by 13 of the 16 participants was adequate. Further, given that participants were generally satisfied that I had captured their responses accurately, only in some cases elaborating and adding more data, there appeared to be no pressing need to seek out input from the remaining three participants.

Challenges Encountered During Data Generation

Studies of this magnitude generally have their own challenges and my study was not an exception. One of the notable challenges that I encountered during my data generation was that two of my participants transferred from their original schools through promotion immediately after Interview One. The schools they relocated to were very far from my base which to some extent defeated the aspect of convenience related to distance and accessibility. This also affected my original transport budget. Further to this, there was an increase in the price of fuel. However, given the desire to continue working with these participants, I had to dig deeper into my financial resources.

Secondly, most of the rural schools that participated in my study were located in remote areas which were characterised by poor gravel roads (Moletsane 2012). As previously mentioned above (Table 4.3), my data generation was carried out from 3rd September 2018 to 11th February 2019, a rainy season in South Africa. Bad weather conditions coupled with poor roads made it difficult for me to drive. I struggled to arrive on time. At two of the schools, I had to leave my car approximately a kilometre away from the school because the roads were slippery. In both incidences I had to walk the remaining distances rushing to beat the appointment time. I remained composed and calm because I had left my car close to villages where the people promised to guard against theft and vandalism.

Thirdly, gaining access from school principals presented another challenge. Cohen, Manion and Morrison (2018:535) point out that "Gaining access and permission may be difficult" and can delay fieldwork. In most urban schools, I was granted permission after thorough interrogations, despite my having produced the Ethical Clearance and all the consent letters from the University and DBE.

Permission was granted but with certain clauses and conditions such as:

> *".....make sure you don't disturb teaching and learning". "...we don't normally allow strangers in laboratories but since the Physical Sciences teacher is a member of the School Management Team (SMT) you can go…*" (Principals 2 and 3 Urban respectively)

Such challenges are consistent with Cohen, Manion and Morrison (2018) who assert that the hosts have different views about researchers and their own intentions, therefore, researchers can influence such perceptions by presenting themselves as humble, professional, competent, accommodating, and trustworthy. However, literature shows that some school leaders refuse for their teachers to take part in educational research because some schools lack capacity to participate or the study may require too much work for the teachers (Brevik 2013). Therefore, I had to be formally dressed, respectful, very clear about my study and clearly articulate it in order to sail through in my data generation process. In the next section I discusses the process of data analysis that I undertook.

Data Analysis

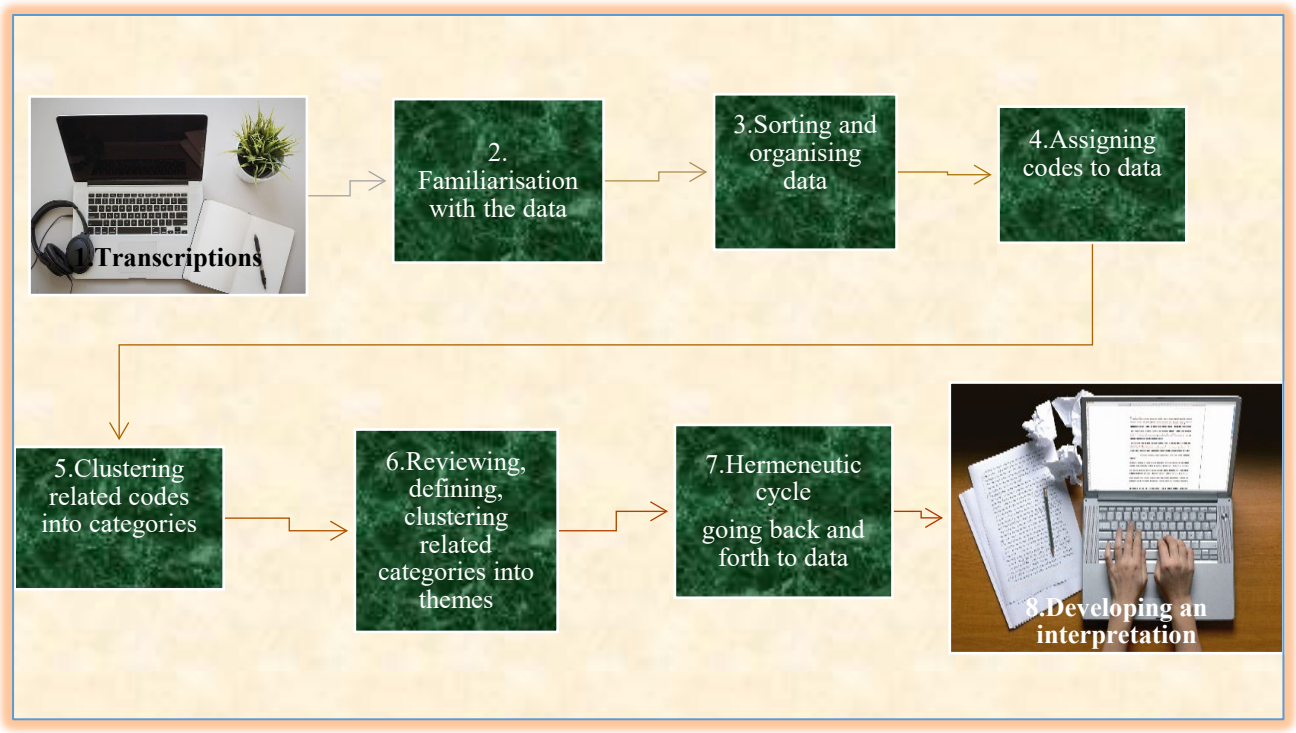
In this study I adopted open coding manual data analysis notwithstanding the many qualitative data analysis computer software packages available on the market. An open coding approach is defined as data analysis which focuses on the coding, categorisation and conceptualisation of phenomena through an intensive analysis of the data (Vollstedt and Rezat 2019). In other words, open coding is an interpretive process by which raw research data are systematically divided into chunks, coded, categorised and then clustered into themes. While computer software packages such as NUD·IST Vivo (NVivo) were available for analysing the qualitative data, I decided to use the manual analysis approach for this particular investigation. This choice was necessitated by a desire to immerse myself in my data and gain a deeper understanding of both my data and the manual open coding analysis approach that I adopted. I, however, decided to reserve the use of NVivo for future, small research meant for publication after experiencing and learning the manual data analysis process. Mukeredzi (2009:360) saw data analysis as "searching for patterns and ideas that help to explain the existence of those patterns". Practically it involves systematically examining and arranging field notes, interview scripts and all the materials gathered in the field, then organising and synthesising them into manageable units.

As informed by Creswell (2014) in this study I employed two approaches to data analysis: in-field analysis and post-data generation analysis. In-field data analysis commenced when I started data generation and continued until the end of the fieldwork. Drawing on Mukeredzi (2009), in-field data analysis enabled me to identify patterns that were emerging from the data, while prompting reflection on what was occurring in the field in answer to questions like what the participants did, how, why, when and with whom they did it. These reflective questions prompted thoughts, feelings, impressions, insights, and observations of what happened during the fieldwork. Mortari (2015) indicates that reflections are vital for connecting incidents occurring during the data generation phase.

The second stage, the post-data generation analysis, constituted the main data analysis phase that I undertook after completing all fieldwork and capturing all data to enable a full picture to emerge (Mukeredzi 2009). I pulled all data from the two interview-series with 16 participants, six document reviews and six lesson observations together for analysis. This helped to avoid repetition and omission of some of the data. This post-data generation open coding analysis was accomplished in eight steps that are presented in Figure 4.3.

Informed by Zucker (2021) from consulted literature, one of the strengths of open coding is that the process enables a deeper engagement with and understanding of data. Furthermore, open coding is inclusive, as it involves identifying and labelling all segments of interest and relevance within the data set and everything that is of relevance within those segments (Zucker 2021). In this study, the approach allowed me to classify possible categories and themes according to the research questions and the central phenomenon to ensure accurate alignment. Although open coding is an important tool for qualitative data analysis, it is very time consuming and tedious (Khandkar 2009). However, it was worthwhile as it provided me great learning that would not have been achieved had I opted to use computer software analysis packages. In analysing the data I followed eight steps as reflected in Figure 4.3 below.

Figure 4.3: Steps followed in data analysis



Source: Researcher 2022

Step One: Transcriptions

According to Hornby (2010:15), to transcribe is to "record thoughts, speech or data in a written form". In this study I transcribed the audio-recorded data into typed prose (transcripts) verbatim. In other words, I took the words of the participants as they were, including non-verbal cues like silences for thought, non-verbal cues, laughter, sighs or arm gestures as these give meaning to the spoken words. Cuddy (2012) advises that body language is indeed a useful tool when one wants to make a point and arm gestures help to paint a picture and get people to understand. On average, it took me four to five hours to transcribe a 50 to 90-minute interview. Azevedo et al. (2017) assert that transcribing requires a significant amount of time, it is boring, and above all it is also a physically exhausting activity. In this study, during transcribing I took regular breaks to avoid getting tired; this improved my concentration, speed and attention. I did my own transcriptions to avoid losing grip of the data that I had mustered during the generation processes. Moreover, I did this in order to be personally involved and immersed in my data, to familiarise myself with it and understand the patterns emerging before the actual data analysis (Mukeredzi 2009). This also ensured participants' privacy, thereby observing

ethical considerations. After each face-to-face interview, I quickly transcribed the audio recordings into typed scripts and printed them. Daily transcriptions were intended to enhance accuracy as the interviews were still vivid in my mind. Printing them was done for the purpose of member checking with participants as I would take them back to participants to member check during subsequent data sessions. I also created a folder on my computer where I saved all the transcribed documents. Following transcriptions, I then sorted and organised the data.

Step Two: Familiarisation with Data

Erlingsson and Brysiewicz (2017) view familiarisation with data as an important step in the data analysis process where researchers need to read and re-read the transcribed interviews while keeping the purpose of the study in focus. In this study, I read the transcribed interviews several times and listened to the audio recordings repeatedly to understand what participants said, to determine categories and themes that were emerging.

As I was familiarising myself with the data, I listened carefully and looked out for patterns and meaning in each interview transcript, while making notes that I would use when I began data analysis (Terry et al. 2017). I also engaged in bracketing and reduction of my own biases by keeping an open mind and focusing on the purpose of the research in order to enter the unique world of the participants interviewed (Cohen, Manion and Morrison 2018). I further wrote down expressions which were in line with the research questions, asking myself questions such as: What are the quotes saying in relation to the research questions? What does this mean to me? What exactly are the participants' beliefs? What is the key message I am getting from the quote? All these questions helped in understanding and familiarising myself with the data, and in understanding the emerging themes before the actual data analysis. Thorne (2000) points out that a researcher's capacity to think deeply is a pre-requisite in data analysis. I was guided by the reflective questions indicated above which prompted critical thought during the analysis process.

Step Three: Sorting and Organising the Data

The next stage involved reading through the text-based data to obtain a clear sense of the participants' responses. At this stage, I sorted and organised data according to research questions. This was to ensure that I had adequate data that addressed each research question. I kept the data from the different contexts separate under each question and marked the data in such a way that I could easily identify data from a particular context. I did this as informed by Cohen, Manion and Morrison (2018) who state that organising and sorting data under each

research question enables the researcher to see the similar patterns and themes at a glance. Therefore, sorting and organising data according to the research questions helped in managing and accessing data quickly during subsequent data analysis processes. Keeping data in small units saved time as I did not always need to go back to the chunk of data but could go straight to the organised data for the specific theme and research question. Thus, keeping research purpose and questions clearly in focus, helped me to merge related responses from the face-to-face interviews, lesson observations and document reviews under the different research questions. Following this, I started step four where I developed the codes.

Step Four: Generation of Codes

This stage of coding involved organising material into segments of text before bringing meaning to information (Mukeredzi 2009). This involved taking text data segmenting sentences into classifications and labelling those categories with a term often in the actual language of the participant, which Cresswell calls an '*in vivo'* term. The stage required examining transcript by transcript, asking the question 'what is this about?' (Mukeredzi 2009). Blair, Imai and Zhou (2015) define a code as a label that is attached to a phrase or a short sentence of the data being analysed. For this reason, coding is also known as indexing. First, I marked different key words, and phrases with highlighters according to the research questions. Second, I then assigned names (codes) next to the data using participants' real words. After this, I wrote the codes in a column adjacent to the chunked data.

After assigning codes to all chunks or segmented data, I then went through the identified codes and clustered similar or related ones to formulate main topics, different topics and outliers. Literature reviewed (Farooq 2018) purports that during the coding process the researcher could experience him/herself gradually becoming immersed in the world of the texts (interview transcripts) as s/he moves from the parts (codes, categories and themes) to the whole (interview transcript) and back again. I went back to the transcripts, comparing the sorted and organised data to check whether I had captured all the codes.

Given that I had employed three data generation methods, I had to collate the responses that addressed the same issues and led to the same findings, in some way keeping them distinct by labelling according to the data generation technique. I could easily identify the repeating codes that were related to a specific research question, such as the nature of Physical Sciences teacher attributions to their pedagogical practices. This approach was in line with the views of Wiggins (2017), who asserts that when employing an open-coding approach, emerging codes have to be

compared with previous codes and amended if necessary. Highlighting codes and initial names assigned also helped me to quickly extract appropriate quotes during the write up process. I sent all the identified codes to my supervisors to help identify any discrepancies, errors, or omissions and then made the necessary adjustments to enhance dependability.

Step Five: Clustering Related Codes into Categories

The coded data were revised and cross-checked before I clustered assigned codes into categories. I had to compare my codes, generalising them and finding connections between the codes (Yin 2017). I also had to look at the text segmented data to confirm the codes before clustering similar and related codes into categories and labelling each category with a term or phrase which emerged from the participants' actual words. Alase (2017) asserts that this stage is described as the category phase which allows the researcher to narrow down to extremely few words the responses of the participants. I did as Alase (2017) suggested, which helped me to capture the central meaning of the participants' 'lived experiences' in one or two words. This step was faster than the third step as I was no longer using voluminous data. This open coding helped me to reduce the bulky data into smaller pieces of purposeful data as I looked only for the underlying meanings.

Step Six: Generating Themes

The sixth stage of data analysis was to review, refine and cluster related categories into themes. Mukeredzi (2017) views this as a stage of scrutinising categories of relevant meaning into themes and attaching names to those themes. I reviewed all of the data, made sense of it and organised clustered related or similar categories into themes that cut across all of the data sources. The themes were then linked and connected to the research questions before final adoption for the descriptive data analysis. This process helped me to formulate names and clear definitions of each theme. One of the benefits of using open coding data analysis is its flexibility. The researcher can identify themes, revise, and modify them in various ways, and the data will still deliver rich and detailed results (Braun and Clarke 2012). Cohen, Manion and Morrison (2011) recommend the involvement of independent judges and, informed by this, I sent the data set to my supervisor and co-supervisor to check for errors and omissions throughout the process of coding, categorisation and theming to confirm my themes.

Step Seven: Hermeneutic Cycle

Hermeneutics is often described as a theory of both understanding and interpretation (Robinson and Kerr 2015) as it offers researchers both a 'philosophy of understanding' and a 'science of textual interpretation' (Peat, Rodriguez and Smith 2019). At this stage I went back to the themes, reviewing, comparing, and contrasting them, checking for overlaps, and scrutinising the themes again for distinctness to decide whether splitting or combining was necessary. I scrutinised the themes again for understanding, continuously moving back and forth throughout the codes and categories to see whether they were all represented in the themes. This was in line with Peat et al. (2019) who assert that the hermeneutic underpinnings of interpretative phenomenological analysis (IPA) offer researchers the opportunity to go beyond surface level description of findings, to offer insightful interpretative accounts of the lived experiences of participants. Reviewed literature (Flick 2006) further suggests that at this stage there is a need for involvement of an independent judge for verification of categories of relevant meaning, relevant to research questions. In this study, therefore, I engaged my main supervisor to verify and confirm themes to help in eliminating errors and discrepancies, and to identify any omissions. Having been satisfied, I then went back and examined the data looking for verbatim quotes by the participants linking them to particular research questions and themes, and ensuring appropriate representation of the different participants and different contexts to strengthen the report.

In Table 4.4: below I illustrate how I coded, categorised, and developed themes and sub-themes.

Table 4.4 Research Question One: **What is the nature of Physical Sciences teacher attributions to their pedagogical practices in secondary schools?**

Data	**Codes**	**Categories**	**Themes**
-One thing I do not enjoy about Physical Sciences is lack of resources like laboratories and few science kits. You find that some of them are incomplete and you try to enquire about that, the only thing the school can offer are books only. -you see in Physical Sciences we do experiments, you need to do experiments to prove to learners that things go the way they do but then you find that in all grades do not have such chemicals and apparatus, they are not supplied. It's frustrating. -My challenge is based on experiments. When I want to conduct experiments, I run short of resources. So, that's why I say at times I don't enjoy teaching the subject.	-Lack of resources -Lack of laboratories -Few science kits Incomplete science kits. -Need to do experiments -Do not have chemicals and apparatus. Chemicals not supplied Challenge on experiments -Short of resources	Under sourcing Under sourcing Under sourcing	Lack of resources

Step Eight: Development of an Interpretation

The final stage of data analysis involved the conceptualisation of themes and development of a narrative (Holmlund, Lesseig and Slavit 2018). I had to step back to reflect on and examine the emerged themes from each of the three contexts in order to identify the differences and similarities. This guided me to organise the narrative that depicted the nature of Physical Sciences teacher attributions to their pedagogical practices and how they shaped their professional growth. As informed by Bekker and Clark (2018), in my write up, I had to insert evidence of the themes from the data by including sufficient data extracts from the individual face-to-face interviews, document reviews and lesson observations to illustrate the prevalence of the theme, using vivid examples of quotes which captured the essence of the points I wanted to demonstrate.

I reported data thematically according to research questions in order to avoid repetition of similar quotes, patterns and themes from the participants across the three contexts. These

themes were then linked and connected to the concepts and principles drawn from the theoretical frameworks and literature reviewed which helped me to provide a rich and thick description (Tracy 2010) of the nature of Physical Sciences teacher attributions to their pedagogical practices. Having discussed data analysis, next I discuss the limitations of the study.

Limitations of the Study

Every study has its own limitations and my study was not an exception. It was my duty as the researcher to acknowledge them and explain how they were addressed in the study to minimise their impact on the findings. First, methodological limitations played a part as findings of this study may not be generalised given the methodological choices. The philosophical and methodological orientations, including sampling designs and sample size, minimised generalisability of the findings. However, the strength of these research findings rests in the multiple-site case study design adopted for the study. Furthermore, a description of the research settings was provided, including thick descriptions in reporting findings to allow readers to make decisions on transferability and applicability of findings to other similar settings. Thus, transferability of the findings of this study may be applicable to similar specific groups, contexts, communities and/or circumstances (Creswell 2008) and the decision will be left to the researcher or reader to confirm findings based on their understanding and experiences.

The research sample was drawn from different geographical locations: deep rural schools, township schools and urban schools where different educational variables (Moletsane 2012; Hugo et al. 2010) had the potential to distort the research findings. The extreme differences between the rural context, and urban context could have influenced the nature of Physical Sciences teacher attributions to their pedagogical practices. However, the inclusion of participants from township schools, a context viewed as the mid-point between the urban and rural schools helped in reducing the educational disparities that had the potential to distort the research findings.

Mukeredzi (2009) asserts that the researcher's attitudes and opinions, combined with tendencies to view participants in their own image or even to seek answers subscribed to their own notions and beliefs may affect the findings. Moreover, researcher misperceptions on given answers or misinterpretation of participants' answers may impact on research findings (Mukeredzi 2009). An effort was made to bracket my own notions and pre-conceived ideas (on the nature of Physical Sciences in secondary school) and to be open minded, following up on

questions to get accurate information and clarifications, remaining quiet and not interfering with participants when they were talking. Further, in this study, I also declared my own axiological assumptions and experiences. The next section discusses ways of enhancing rigour that were adopted in this study.

Trustworthiness of the Study

Lietz and Zayas (2010) suggest that qualitative studies should not focus on validity and reliability but should achieve 'trustworthiness'. Qualitative studies do not look at internal and external validity because they have no hypothesis but only focus on whether the study is trustworthy. Informed by Lietz and Zayas (2010), in this study I undertook all the necessary procedures that would ensure the trustworthiness of my research findings. Trustworthiness is defined as the degree of confidence in the research findings, the interpretation and the methods used to ensure the quality of the study (Polit and Beck 2014). In pursuit of trustworthiness in a study, qualitative researchers put more emphasis on the four criteria outlined by Lincoln and Guba (1985): credibility, transferability, confirmability and dependability of the research findings. These are discussed in turn below.

Credibility

Creswell (2012) asserts that credibility is present when the research results mirror the views of the people under study. Credibility relates to the stakeholders' confidence in the truth of the findings (Connelly 2016), and the level of objectivity and impartiality of the research findings (Bradshaw, Atkinson and Doody 2017). In this study, this was enhanced by providing thick descriptions when presenting the data and findings. Moreover, in an effort to promote the credibility of my findings, I maintained an open mind, bracketed my own opinions, experiences and knowledge to reduce the risk of bias and avoid in any way influencing the direction of the conversation, ensuring that discussion remained on topic. In this study, individual face-to-face interviews were audio-recorded to avoid misrepresentation of the research participants thereby enhancing credibility. This is in line with Bertram and Christiansen (2014:189) who argue that "using an audio-recording device to record interviews verbatim, means that the transcripts are more accurate than if the researcher simply jots down notes during the interview."

The inclusion of three independent data generation sites, rural schools, township schools and urban schools, as well as employment of three separate data generation techniques, namely face-to-face interviews, lesson observations and document reviews, enabled triangulation, with the possibility of giving credibility to my findings. In addition, qualitative researchers manage

the threat of researcher bias as they seek to achieve credibility by engaging in reflexivity and seek to build self-awareness regarding their own influence on the research project (Drisko 1997). I engaged in dialogues with other doctoral students, presented my work to lecturers and peers during cohort sessions and received feedback. In addition, I constantly consulted with my supervisor and all this prompted reflexivity which enhanced credibility. This was in line with Lietz and Zayas (2010) who assert that engaging in dialogue with peers and instructors promotes reflexivity – a vital aspect of credibility.

Transferability

Transferability refers to the degree to which the findings are applicable or useful to theory, practice and future research (Lietz and Zayas 2010). On a similar note, Sandelowski (1986) refers to transferability as 'fittingness' suggesting that it has to do with the degree to which findings fit situations outside of the study. Transferability, which is synonymous with generalisability in quantitative research, demonstrates that findings in qualitative research may be applicable to other contexts (Lietz and Zayas 2010). In this study in order to enhance transferability, I provided details of the research sites showing the location of my research participants. The sample of my study included Physical Sciences teachers drawn from rural schools, township schools, as well as urban schools. I identified and sampled Grade 12 Physical Sciences teachers who had similar characteristics, except for the contextual differences. Gasson (2004) suggests that transferability is achieved when the researcher provides sufficient information about the self and the research context and research sites, processes, participants, and the researcher-participant relationships to enable the reader to decide how the findings may transfer. This was the case in this study. Consequently, the thick descriptions that I provided in describing the research sites, as well as in presenting findings, assisted in enhancing transferability. Transferability in this study was, therefore, left to the reader, bearing in mind that this would be based on the understanding that findings were limited only to specific similar groups and contexts.

Confirmability

According to Leitz and Zayas (2010), confirmability means the capability of other people to confirm or corroborate the research findings. In other words, it is the degree to which research procedures are documented, allowing someone outside the project to follow and critique the research process (Padgett 2008). During the data analysis stage, discussion with other doctoral

students during residential cohort sessions who had to critique, evaluate and confirm my analysis procedures, thereby promoted chances of the confirmability of my research findings.

In literature surveyed (Lietz and Zayas 2010) confirmability can also be increased by keeping an audit trail and engaging in peer debriefing. An audit trail is a written account of the research process that includes reporting what occurred throughout the research project along with a demonstration of reflexivity which I referred to above. In this study, I kept an audit trail of my entire research process, documenting what occurred throughout and reflecting on the process of data generation where I recorded the meetings with the participants, their reactions and decisions made. Literature surveyed (Pandey and Patnaik 2014) asserts that it is important to keep an audit trail (a written account of the research process, including appointment dates and what transpired on each particular day) to show a transparent description of the research steps taken from the beginning of a research study to the development and reporting of findings. As alluded to above, frequent consultation with my supervisor, sending her all interview transcripts in order to get clear guidance, assisted me to keep focused and enhanced confirmability.

Colorafi and Evans (2016) assert that confirmability can be achieved through the researcher's degree of neutrality in the study's findings. This means that the research findings have to be based on the participants' responses and not any potential bias or personal motivations of a researcher. In my case I had no prior interactions with the research participants before the start of the research process. My data generation techniques involved a list of guiding questions – face-to-face interview schedule, a document review checklist and a lesson observation checklist (Appendix One). Drawing from Yin (2012) and Creswell (2014), the use of guiding questions helped in minimising researcher bias and the threat of research reactivity.

Dependability

Dependability is the extent to which the study can be repeated by other researchers with the findings remaining consistent (Connelly 2016). A qualitative study can be said to be trustworthy if it is also dependable. In this study, maximum effort was made to ensure that data generation and data analysis were done as accurately as possible. I did my transcriptions immediately after data generation, whilst the events were still fresh in my memory. The participants were free to express their views. Moreover, my data analysis was centred on the raw data: recorded, observed and written to enhance dependability.

Some strategies used to increase dependability include keeping an audit trail and engaging in peer debriefing (Leitz and Zayas 2010) – all discussed above. In this study, keeping an audit trail also enabled rectifying errors, improving the interviewing process and time management skills throughout the journey of data generation, and the development of the research report. As noted above, peer debriefing and assistance from my supervisor helped in promoting dependability or auditability of my research findings. Yin (2012) further states that peer debriefing enhances the research process by generating new ideas and identifying potential pitfalls related to methodology, therefore, adopting the approach was an effort to increase dependability of the findings. The discussions that I held with peers (doctoral students) during residential sessions helped in enhancing dependability of my study.

Having discussed trustworthiness as a way of enhancing rigour, the following section focuses on ethical considerations that were undertaken throughout this study.

Ethical Considerations

Weis (2019) in literature consulted asserts that solid up-front ethics that are approved by institutional advisory boards are crucial to ensure that researchers have done their best to identify possible ethical issues prior to data generation and offer deontological safeguards. Cohen, Manion and Morrison (2018) state that ethics is concerned with that which is right and wrong, good and bad, what the researcher ought and ought not to do in their research. In other words, ethical issues and considerations are not a once-and-for-all matter which can be valued before the research begins or when the proposal is submitted to an ethics committee, and then forgotten (Brooks, te Riele and Maguire 2014) but rather, they are continuously followed throughout the whole research process and beyond.

The participants of this study were Physical Sciences teachers whose rights, needs, values and desires needed to be protected. I made every effort in this investigation to ensure that no violation or injury was inflicted on the research participants or any other stakeholders who had something to do with my study. The participants were not asked to perform any acts or make statements which could cause discomfort, compromise them, diminish their self-esteem or cause them to experience embarrassment or regret. The idea was to protect their personal dignity.

In this study, I first sought permission – Ethical Clearance from the Durban University Technology (DUT)'s Institutional Research Ethics Committee (IREC) to undertake this research, as highlighted under the heading 'gaining access' above. I did this as informed by

Fleming (2018) who asserts that approval has to be granted first before data generation from human participants can be carried out.

I adopted three principles of ethical consideration which are prescribed by Hammersley and Traianou (2012): minimisation of harm; respect for autonomy (signing of informed consent); and the protection of privacy (addressing confidentiality and anonymity). With regard to minimisation of harm, I tried to ensure that the teachers studied were not exposed to any harm: physical trauma and social infliction of pain during data generation. In relation to autonomy, I gave the participants time to read the letter of information and informed consent forms and then went through each point with them to help them clearly understand before signing. Grady et al. (2017) state that participants should sign informed consent after the researcher has explained the purpose of the study, benefits, or dangers of their participation so that they understand before they make informed and voluntary decisions to participate in the study. It was up to the participants to weigh any risk or harm and benefits of participating in the research and then decide whether or not to take part. All participants expressed willingness to participate in my study by signing the consent letters. Further, I explained that the audio recordings would be saved on a memory stick, transcribed and the printed scripts would not be shared with anyone else except my supervisor and used for research purposes only. All these were kept in a locked safe with all the other research items by my supervisor and would be destroyed after five years. Files saved on my laptop were saved in a password-protected folder and would be destroyed after five years. This is in line with literature surveyed where Cohen, Manion and Morrison (2018) posit that files, audio data, questionnaires, video data, computer files must be stored during the research and destroyed sometime thereafter.

Lastly, the confidentiality, anonymity and the rights of all of the research participants were preserved in this study by not revealing their real names during reporting study findings. Fleming (2018) notes that confidentiality includes the avoidance of using self-identifying statements. As informed by Siti (2018), the research participants were referred to by their codes as indicated in Table 4.3 above. Significant findings emanating from the research process would be made available to all participants on request. Drawing from all of the above, I did not deceive my research participants in any way. The next section provides a summary of this research methodology chapter.

Chapter Summary

This chapter presented the research design and methodology. The chapter discussed the interpretive research paradigm, multiple-site case study research design and qualitative approach which framed and guided the study. It also outlined the sampling process and the sample for the study. The research setting comprised of the three contexts (Rural, Township and Urban) was outlined. The data generation process – through a multi-modal approach in which data were generated using individual face-to-face interviews, document reviews and lesson observations – was also described. The challenges experienced during the research were highlighted, followed by the eight steps of data analysis and the limitations of the study. The last section discussed how rigour was enhanced through aspects of trustworthiness: credibility, transferability, confirmability and dependability. Ethical issues considered throughout the research were then presented and elaborated on.

The next chapter focuses on data presentation and analysis addressing Research Question One about the nature of Physical Sciences teacher attributions to their pedagogical practices.

CHAPTER FIVE

DATA PRESENTATION AND ANALYSIS:

The Nature of Physical Sciences Teacher Attributions to their Pedagogical Practices in Secondary Schools

Introduction

The purpose of the study was to explore Grade 12 Physical Sciences teachers' attributions to their pedagogical practices in UMzinyathi secondary schools and how these attributions influence their professional growth. In Chapter Four, I described methodology adopted for this study where I illustrated that the study is located in an interpretive paradigm which adopted a qualitative approach. Data were generated from 16 purposively drawn Physical Sciences teachers from rural, urban and township schools. Individual face-to-face, two series interviews, document reviews and lesson observations were employed as the main data generation tools. In the methodology chapter, I also described the research setting where I defined the settings from where data were generated and analysed.

This chapter presents and analyses the data on Physical Sciences teacher attributions to their pedagogy. As alluded to in Chapter Three, the study draws on two theories: the theory of attribution by Weiner (2005) to understand the nature of attributions addressing Question One, and Bell and Gilbert's (1996) Aspects of Professional Learning to understand the influence of attributions on professional growth which is Question Two. Thus, the present chapter draws on the attributions theory to unpack, understand and explain the findings. Some of these attributions are internal to the teacher, such as lesson preparation, lesson delivery, classroom management and subject content knowledge (SCK). Such internal attributions are within the teachers' control and he/she can change them. However, external attributions, such as progressed learners, shortage of resources, learner family background and learner attitude towards the subject are beyond the teacher's control (Weiner 2005). Internal and external attributions combined help in understanding the nature of Physical Sciences teacher attributions to their pedagogical practices.

I also draw on literature surveyed in Chapter Two to illustrate how my findings relate to existing research.

In this chapter, the findings from all data sources – the interviews, document reviews and classroom observations – are integrated and presented together because the responses were broadly similar.

The study revolved around one key question: To what do Physical Sciences teachers attribute their pedagogical practices and how do the attributions shape their professional growth?

This main question was unpacked through two sub questions:

1. What is the nature of Physical Sciences teacher attributions to their pedagogical practices in secondary schools?
2. In what ways do the Physical Sciences teacher attributions shape their professional growth?

In this study, each research question constitutes a chapter. This chapter focuses on Research Question One which discusses the nature of Physical Sciences teacher attributions to their pedagogical practices in secondary schools. It is through these attributions and conceptions that teachers may develop their own "knowledge-in-practice" which is teacher knowledge that is constructed through their everyday teaching practices and experiences (Mukeredzi 2013) to assist learners. This kind of knowledge-in-practice that the teachers develop through their teaching experiences will contribute to their professional growth.

In this study, participants and research sites are identified by codes to ensure confidentiality and anonymity. Teachers are identified as Teacher 1 to Teacher 8. Research sites are identified as Rural School 1-8, while Urban and Township Schools are represented by Codes Urban or Township School 1-4. Data generation techniques are also identified by codes as follows: Face to face Interviews = FFI, Document Reviews = DR and Lesson observation = LO.

The chapter is organised into five sections. Immediately after this introduction, I present and discuss the biographical data of participants. Subsequent to this, the chapter discusses the research findings under the themes and subthemes that emerged from the data. There follows the chapter summary which ties up all the findings from this chapter.

Biographical data of participants

Table 5.1: Biographical data of participants

Participant	Gender	Age (Years)	Qualifications	Teaching Experience (Years)
Teacher 1 Rural	Male	47	B.Sc, Grad CE	21
Teacher 2 Rural	Male	37	NPDE, ACE	11
Teacher 3 Rural	Female	42	NPDE, ACE	18
Teacher 4 Rural	Male	28	B.Sc, PGCE	3
Teacher 5 Rural	Male	36	B.Ed	11
Teacher 6 Rural	Male	41	NPDE, ACE	13
Teacher 7 Rural	Female	42	ACE	16
Teacher 8 Rural	Male	51	CE, B.Ed	26
Teacher 1 Township	Male	41	NPDE, ACE	13
Teacher 2 Township	Male	42	B.Ed	14
Teacher 3 Township	Female	33	B.Ed	9
Teacher 4 Township	Male	28	B.Ed	4
Teacher 1 Urban	Female	48	M.Ed.	21
Teacher 2 Urban	Male	43	NPDE, ACE	16
Teacher 3 Urban	Male	49	B.Sc, Grad CE	23
Teacher 4 Urban	Male	32	B.Ed	8

KEY (on Qualifications):

ACE = Advanced Certificate in Education

B.Sc = Bachelor of Science

B.Ed = Bachelor of Education

CE = Certificate in Education

Grad CE = Graduate Certificate in Education

NPDE = National Professional Diploma in Education

PGCE = Post Graduate Certificate in Education

Table 5.1 above reflects the biographical data of participants in this study. Given the link between attributions and a person's demography (Adams 2012), an analysis of biographic details of participants was vital. As discussed to some detail in the Methodology Chapter, of the 16 study participants, eight were teaching in rural schools and four each were in urban and township schools. Also, as explained in that chapter, as the research site is broadly rural, as such more participants were drawn therefrom. In terms of gender, they were four female participants in this study, two from rural schools and one each from township and urban schools. Having only four women participants teaching FET Grade 12 Physical Sciences was apparently because sciences and mathematics have always had a shortage of female students

and teachers. This is consistent with literature (Farley 2014; Wang and Degol 2017) which indicates that women are under-represented in Science, Technology, Engineering, and Mathematics (STEM) careers.

However, studies, (Peacock 2009; Erten and Burden 2014; Ghonsooly et al. 2015) show that both male and female teachers attributed their successes related to pedagogical practices to internal causes. The only difference was that male teachers attributed success to ability whereas female teachers attributed it to effort. Further, literature surveyed (Erten and Burden 2014) shows that female teachers tend to attribute their failures in pedagogical practices to external attributions, while males ascribe it to internal attributions. Nevertheless, some other researchers (Wu 2011; Pishghadam and Motakef 2011) point to the fact that there are no significant differences between male and female teachers in their attributions for their pedagogical practices.

With reference to the age of participants, they ranged from 28 to 51 years with an average of 40 years. Literature consulted (Peacock 2009; Pishghadam and Motakef 2011; Erten and Burden 2014) shows that age influences teacher attributions of what happens to them in and outside the classroom. The same sources point out that mature teachers tend to attribute their successes and failures related to classroom practice to both internal and external factors whereas young teachers do not accept blame for failure hence they would attribute their successes to internal factors and failures to external factors.

As reflected in Table 5.1, all participants were professionally qualified with the majority possessing a Bachelor of Education degree (B.Ed) specialising in Physical Sciences. Of the eight rural participants, four were holders of NPDE plus ACE qualification or just an ACE qualification. There was only one participant with a post graduate qualification, Master's degree in Education (M.Ed) who was teaching in an urban school and the urban and township participants together had only two with NPDE plus ACE. The least qualified participant had an ACE and was teaching in a rural school.

These differences in the qualifications resonate with Adams (2012) who asserts that, the world over, top ranked schools in urban and township contexts have higher percentages of high-ranking teachers in terms of their qualifications compared to schools in rural areas. In addition, literature surveyed, (Maphoso and Mahlo 2015) indicates that compared with rural areas, urban areas historically have a higher share of teachers with bachelor's, postgraduate and professional

degrees. This assertion is consistent with the data in Table 5.1 above where only half (4) of the participants in rural schools had teaching degrees compared to the urban and township participants together which had six out of eight with degrees. Adams (2012) further indicates that in many developing countries such as South Africa, schools in rural areas employ teachers with less preparation, less experience, and less subject knowledge than schools in urban areas. Drawing from Table 5.1, the average teaching experience of rural participants was lower (15 years) than the average teaching experience of urban participants (17 years) and the highest qualified teacher in these participants (with M.Ed) was in an urban school hence my data confirms Adam's (2012) findings. Consequently, this uneven distribution of teachers may influence teacher attributions and ultimately, may result in an achievement disparity between learners who live and learn in different communities. However, juxtaposing the above qualifications with the South African Relative Education Qualification Value (REQV) (Department of Education, 2007), all these teachers held minimum requirements for qualified teachers - the REQV level 14 as they possessed either a four-year bachelor of education, a three-year undergraduate degree plus a one-year post-graduate professional diploma/certificate or an Advanced Certificate in Education (ACE) (Bertram, Mthiyane and Mukeredzi 2012).

With regard to teaching experience, the most experienced teacher had 26 years of teaching and the participant with the least number of years in the field had three years, and both these teachers were teaching in rural schools. Still on teaching experience, only a quarter (2 out of 8) of the rural teachers had teaching experience above 20 years and this was also the case with the urban and township participants combined. Further, as alluded to above urban, and township schools had more teachers with at least an undergraduate degree than rural schools. Drawing from the attribution theory (Weiner 2005), teachers with less SCK and less teaching experience tend to attribute their pedagogical practices to external, (uncontrollable) factors such as learner and school factors. However, still drawing on attribution theory, teachers with adequate SCK and more teaching experience attribute their practices to both internal (controllable) and external (uncontrollable) factors (Weiner 2005).

In relation to the teachers with less teaching experience based in rural and township schools, Adams (2012) asserts that schools serving low income students are often staffed with teachers with less experience and education than schools attended by their middle-class counterparts. Adam's (2012) assertion relates closely with the findings in Table 5.1 where the majority of participants- mostly holders of NPDE plus ACE qualification coupled with few years of experience, were teaching in rural schools of the UMzinyathi district. Gardiner (2008)

described as one of the poorest and least developed South African rural communities that are located in the former homelands. Homelands are areas that were established by the Apartheid Government as areas to which the majority of the Black population was moved to prevent them from living in urban areas of South Africa (Mukeredzi 2013). This was part of the grand Apartheid strategy of 'separate development'.

Aside that, Kini and Podolsky (2016) observed that the quality of any education system depends on the quality of its teachers and that the most important school‐based determining factor of students achievement is teacher quality. If we take teacher qualification as implying teacher quality, then urban and township schools in this study, where teachers studied held higher qualifications, had more quality teachers compared to the rural schools. More experienced teachers support learner-learning effectively drawing on their attributions irrespective of the school environment (Kini and Podolsky 2016). Consequently, experienced teachers in rural schools regardless of the conditions would be expected to draw on their experiences and attributions to enhance learner achievement. However, the same source also indicates that the passage of time does not make all teachers better or make incompetent teachers effective, albeit for most teachers, effectiveness increases with experience.

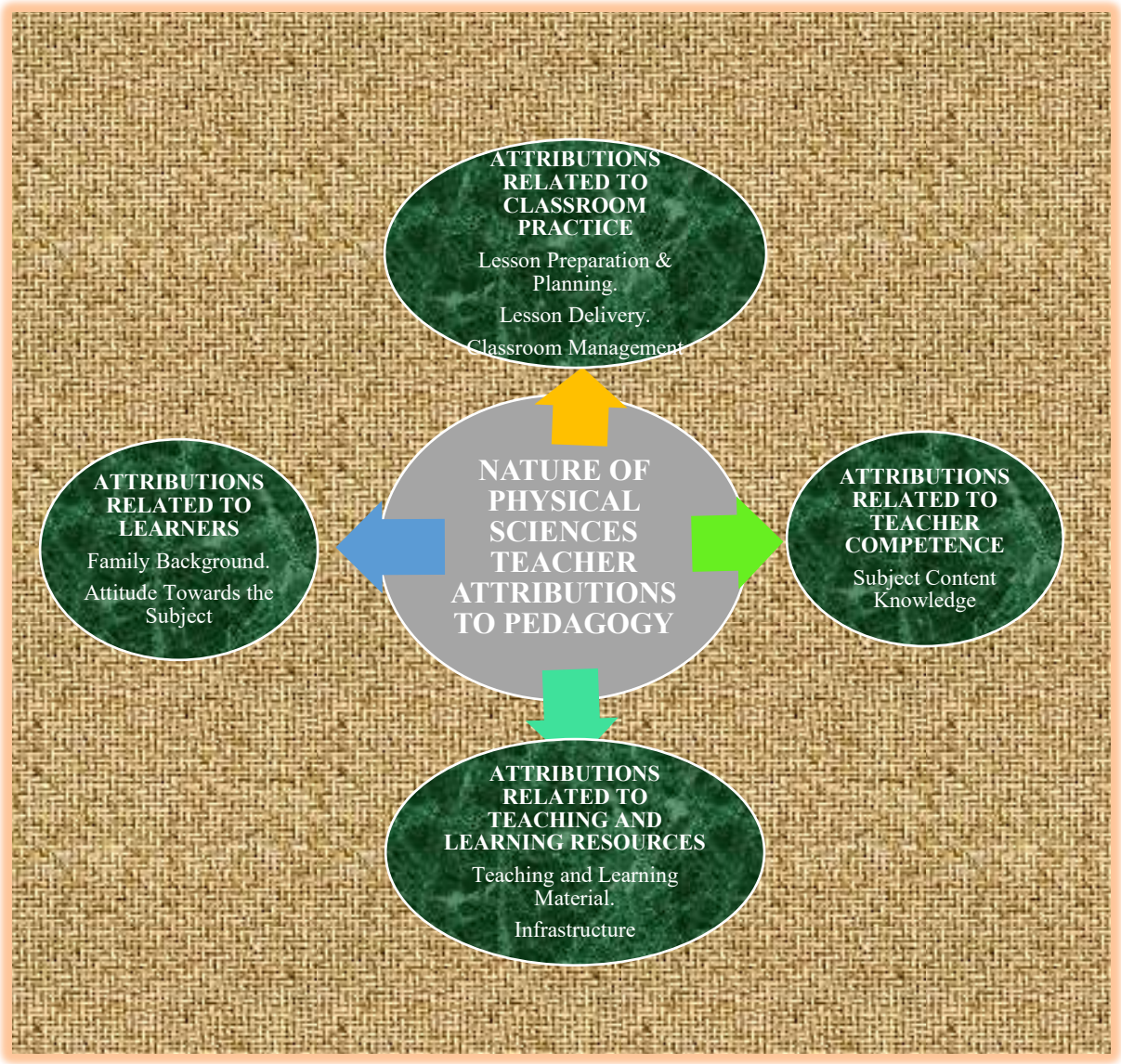
Studies done by other scholars (Kimani et al. 2013; Musau et al. 2013) found that teachers' professional qualifications and teaching experience have no bearing on teacher attributions and are not significantly related to students' academic achievement. On the contrary, studies (Olayeye 2011; Kini and Podolsky 2016; Maphoso and Mahlo 2015) provide enough evidence that teacher attributions emanate from their teaching experience, and educational qualifications and such attributions significantly influence learners' academic achievement. However, it is generally understood that teachers, drawing on their attributions and experiences can influence learner achievement as such teachers often possess good communication skills, strong work ethic, organisational skills, preparation, and discipline among others. Consequently, teacher attributions to their pedagogical practices emanate from diverse factors including those highlighted above. Having discussed the teachers' biographical data, in the next section I present and discuss the themes and sub-themes that emerged in addressing research Question one.

Themes and Sub-themes

Question One which this chapter attempted to answer was: *What is the nature of Physical Sciences teacher attributions to their pedagogical practices in secondary schools*? The four

main themes addressing Question One that emerged from the findings are teacher attributions related to classroom practice, teacher attributions to teaching and learning resources, teacher attributions related to learners and teacher attributions related to teacher competence. The themes that emerged from the data and their sub-themes are discussed and summarised through their sub-themes in the next section.

Figure 5.1 Themes and Sub-themes on the Nature of Physical Sciences Teachers Attributions to their Pedagogical Practices



Source: Researcher (2022)

Figure 5.1 above illustrates the main attributions (main themes) that emerged from the data and the sub-themes.

Table 5.2 Responses from all participants in relation to each theme.

Settings & Participants		**Main themes & their Sub-themes**						
		Classroom Practice			Attributions Related to Resources	Attributions Related to Learner Factors		Attributions Related to Teacher Competence
Sites (Rural, Township and Urban Schools)	**Participants**	Lesson Preparation	Lesson Delivery	Classroom Management	Teaching & Learning Resources	Learner Family Background	Attitude Towards the Subject	Subject Content Knowledge
	Total	**16**	**16**	**16**	**11**	**8**	**11**	**12**

Table 5.2 above illustrates the number of responses for each theme and sub-theme. Classroom practice was the common theme across all 16 participants as their attributions linked to it. Attributions related to teacher factors were recorded by 12 participants. A full discussion of each major theme reflected in the table follows in the next section and a detailed table with all individual responses is in the Appendices section (see Appendix Ten).

Classroom Practice

Classroom practice refers to all the activities that a teacher does that are related to their work of teaching and to the learning of learners. In this process, both the learner and the educator benefit. From analysing data on Classroom Practice, three sub-themes emerged, namely, lesson preparation, lesson delivery and classroom management. These sub-themes are discussed separately in the next section.

Lesson Preparation and Planning

Lesson preparation involves the planning of a lesson to be taught focusing on what to teach how to teach it, learner activities and the media to be used. The lesson plan is a way of preparing for a classroom experience that requires activities for the learners and the teacher which Mukeredzi (2013) regards as a descriptive document or activity and a content-planning tool that indicates everything a teacher needs to do during his/her classes. When planning a lesson, teachers often attribute their planning to the nature of their learners, availability of resources and size of class. Teacher attributions related to lesson preparation are critical as they determine the success or failure of a lesson, in other words, lesson preparation enhances the effectiveness

of the teaching/learning process. This is confirmed by literature surveyed (Van der Westhuizen, Mosoge, Niewoudt and Steyn 2012) that lesson preparation is essential for a successful lesson and when there is inadequate teacher preparation, poor teaching results. Mukeredzi (2013) summed it up saying by failing to prepare, a teacher prepares to fail. In South African schools, lesson preparation is generally informed by documents from the Department of Basic Education: the Curriculum Assessment Policy Statement (CAPS) and the Annual Teaching Plan (ATP). The CAPS document indicates content to be covered per topic including specific aims but does not explain how the topic should be taught. Therefore, it is in the lesson plan where teaching strategies and steps are clearly explained sequentially.

The Annual Teaching Plan (ATP), on the other hand, is a structured document showing the content to be covered per week, number of formal and informal tasks and weighting of each task to be covered per term (CAPS 2013). These two official documents, including set text books, guide the teacher in lesson preparation and planning (CAPS 2013). The use of these documents was evident in the document reviews and lesson observations that I carried out. All lesson preparation and planning that I observed was drawn from the ATP and aligned to the CAPS document requirements.

In addition, all 16 participants indicated that they attributed lesson preparation and planning to learner ability, available resources, strategies to be used and the examiner's report on the general errors and omissions made by learners in the immediate previous final examinations. Literature surveyed (Moore-Cox 2017) points out that in lesson preparation, teachers should consider students' knowledge and identify their misconceptions in order to choose appropriate methods for teaching science. In other words, they attribute the planning to learner capability and any misconceptions. In a FFI, Teacher 3 in Township School 3 said that:

> *What influences my preparation is the type of learners that I am teaching. Whenever you prepare you ask yourself, are my learners going to understand what I am going to teach them. So, the whole preparation starts from my knowledge of learners. I also consider the resources that I have at my disposal, text books or other sources of information like copies from previous question papers or any relevant material.*

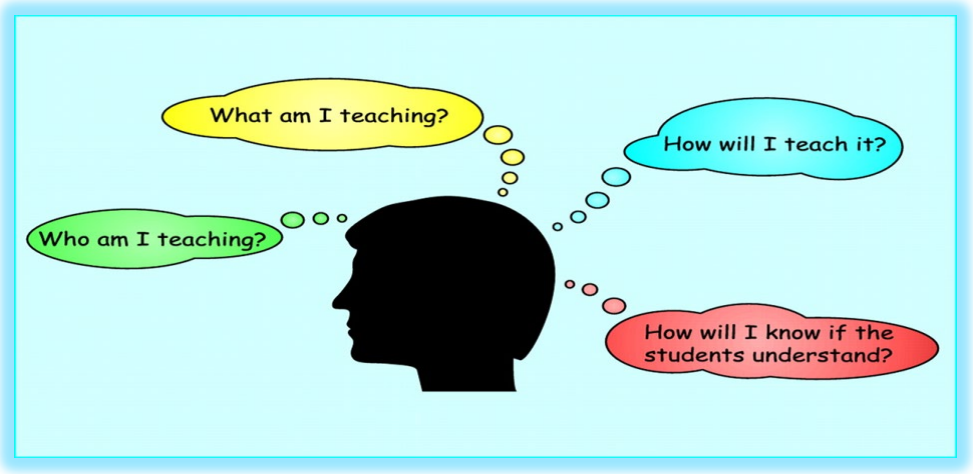
In a FFI, Teacher 6 at Rural School 6 echoed similar attributions saying:

> *Any lesson that I prepare is influenced by the nature of the learners that I am going to teach, how they perform and how they grasp. There are learners who are fast and others who are slow. So, when I sit down to prepare a lesson, in mind I take care of them.*

The above sentiments were also supported by Teacher 2 in Urban School 2 in a FFI who asserted that:

> *When preparing, the first thing I take into consideration is the ability of my learners knowing which learners can easily grasp these concepts or who is likely to struggle with the topic. So, whenever I am preparing, I take care of these two categories of learners. I will then try to simplify my content for the benefit of the struggling learners.*

Figure 5.2 Teacher Mental Picture of Key Attributions in Lesson Preparation and Planning



Source: Google search: www.lesson preparation images

Figure 5.2 above shows a mental picture of the key attributions raised by Teacher 3 Township, Teacher 6 Rural and Teacher 2 Urban on their views on lesson preparation. Figure 5.2 illustrates that teachers attributed their lesson preparation and planning to the nature of learners (who am I teaching?), the teaching strategies to be used (How will I teach it?), the content to be taught (What am I teaching?) and class activities (How will I know if the students understand?). These attributions will be discussed separately under the theme Classroom Practice.

From the above comments, it is evident that Physical Sciences teachers (16) attributed their lesson planning to the ability of their learners. All 16 participants attributed their lesson preparation and planning to learner diversity and they structured their lessons to accommodate both fast and slow learners. From the attributions theory, Yezbick (2016) points out that teachers' belief systems (attributions) – the information, attitude, values, theories and assumptions about teaching and learning – have a great impact on their instructional practices. All this suggests that teachers' lesson preparations, planning and practice are derived from their attributions. In support of the above attribution literature consulted, Moore-Cox (2017) asserts that when teachers explain why they take certain decisions when planning lessons, they consider their pedagogical content knowledge that is relevant for that specific moment, those specific students, that specific topic and that specific context in which they design their lesson. On the value of the lesson planning, literature consulted (Jensen 2011) declared that it serves as a guide during class activities, a resource for the next person who teaches the course or a substitute teacher, and a historical document for teacher review and accreditation. Other literature surveyed (Mukeredzi 2013) states that planning enables thorough preparation and increases teacher efficiency and confidence through "self-interrogating, stepping back, 'pre-playing' and pre-evaluating classroom practices, and teachers develop new knowledge and beliefs on content, pedagogy and student learning" (97).

Other attributions highlighted around lesson planning were about availability of resources for use in the lesson. Many public schools in South Africa have no proper laboratory facilities which makes the teaching and learning of Physical Sciences difficult for teachers and students as it remains at a theoretical level without experiments (Makgato and Mji 2006). What this implies is that learners understand better if they observe chemical reactions during experiments to prove some theories, hence, resources are a key factor in the preparation of lessons. While lesson planning is an internal attribution which the teacher can control, teaching resources are external attributions (Weiner 2005) and the teacher has very little control over such provisions yet they influence his/her pedagogical practices and students' learning. The issue of resources will be dealt with in detail as a stand-alone theme later. Literature consulted (Wu 2011; Pishghadam and Motakef 2011) indicate that there are no gender differences in attribution style. The above discussion confirms this view taking into consideration that Teacher 3 Township, was female while Teacher 6 Rural, and Teacher 2 Urban were male. While the focus of this study was not on gender differences related to teacher attributions it was interesting to

note that both male and female teachers attributed their lesson preparation and planning to common factors.

Other attributions raised by eight participants around lesson preparation and planning included examination reports on common errors. *"Examiner's reports highlight the omissions that were made by teachers which chief examiners found during marking"* (FFI Teacher 2 Urban). So, in lesson preparation such error and omissions reports are considered in preparation and planning so that they are incorporated in the lesson and taught to avoid repetition.

Teacher 2 raised another attribution during FFI in Township School 2 which related to global influences on science. Global influences require that teachers prepare learners for the world of science, a world without problems because of technology. *"So, it's not just about examinations only but about the learner and the world in which he/she is going to live in where technology dominates".* Such information was also incorporated into the lesson plan.

From the above findings the nature of Physical Sciences teacher attributions to their lesson planning related to the nature and ability of learners, learner diversity, the resources to be used, the examination guidelines and identified common errors in reports. According to the attribution theory, these are external (situational) attributions which as the theory asserts, the teacher has very little control over (Weiner 2005). Lesson preparation is basically paper work and once this is ready the practical aspect of the lesson follows, which is lesson delivery.

Lesson Delivery

The nature of Physical Sciences teacher attributions to their pedagogy was also reflected in lesson delivery by all 16 participants. Lesson delivery in this section is discussed under two aspects: teaching strategies and learner activities.

Lesson delivery is the presentation or facilitation of learning in the classroom for concept mastery and development. Surveyed literature (Woolfolk 2007) asserts that lesson delivery is active teaching which is characterised by thorough teacher explanation, together with demonstrations, learner activities and both learner-learner interaction and teacher-learner interaction. Often effective lesson delivery encompasses use of appropriate strategies, active teacher-learner and learner-learner interaction, and learner engagement in activity. Teaching strategies as an aspect of lesson delivery is discussed in the next section.

Teaching Strategies

Teaching strategies, also called pedagogical strategies, are approaches or methods used by the teacher to facilitate learning of concepts in lesson delivery. Literature consulted (Fischer et al. 2018) points out that teaching strategies are a combination of instructional methods, learning activities, and materials that actively engage students and appropriately reflect both learning goals and students' developmental needs. Mukeredzi (2013) in literature surveyed noted that teacher attributions and conceptions determine their pedagogical approaches and choices of materials, content and learner activities. These pedagogical strategies encompass classroom management and learner discipline to enhance effective learning. Choice of strategies is often dependent on the teacher and the learners and content to be taught. As such, Physical Sciences teacher attributions to teaching strategies differ. Explaining attributions to Physical Sciences lesson delivery in a FFI, a teacher said:

> *My teaching strategy is influenced by the fact that Physical Sciences is basically a practical subject. I believe that all Physical Sciences lessons be introduced by a practical demonstration so that at least learners see the direction to where we are heading*. (Teacher 5 Rural).

Teacher 5 attributed lesson delivery of Physical Sciences to the practical nature of the subject. From the above, practicals in Physical Sciences are pivotal in lesson delivery because they are used right from the introduction to the conclusion of the lesson so that learners can visualise the whole concept being taught. Incorporating practical activities in the teaching of Physical Sciences is supported by consulted literature (Vhurumuku 2010) which asserts that testing of ideas is not restricted to chalk and paper but there must be direct involvement of learners in investigative lessons. The researcher further elaborated that demonstration of lessons and chemical reactions should be key components in the teaching of Physical Sciences (Vhurumuku 2010). As such, demonstration becomes central in Physical Sciences lessons. In support, literature surveyed (Cox 2009) emphasises that children learn by doing and by imitation, not just by hearing and they must be engaged in the lesson through hands-on activities following the teacher's demonstration. In other words, learners learn by observation and imitation: after observation, they imitate and practise the action to enhance their understanding. Literature consulted further indicates that learners understand better through observing modelling from a teacher or watching other students perform a task (Josephsen and Hvidt 2015). From the theoretical perspective, resources are external factors (Weiner 2005)

which in this case could not be controlled by the teacher but influenced their pedagogical practices and learner learning.

However, attributions related to lesson delivery differ, as asserted by one teacher in Urban School 2 during a FFI:

> *I believe that when I teach learners firstly, any new content must start from the known to the unknown. I normally build my lesson from the content of the previous grade. I associate my lesson with their everyday experiences.* (Teacher 2 Urban School).

Oftentimes teaching learners from 'known to unknown' referred to above enables learners to have a quick preview of what is ahead in their learning and if these preconceptions are not engaged, learners often fail to correctly grasp new concepts. Mukeredzi et al. (2016) point out that leading learners from 'known to unknown' – regarded as the hallmark of instruction – is particularly useful with young learners as it promotes thinking and observation, providing more scope for participation as learning becomes easy and permanent which develops their self-confidence. This, therefore, involves teaching learners from simple to complex, specific to general, concrete to abstract and example to rule, which according to the authors is the symbol of instruction which creates an association – a background for presenting new knowledge – as it usually creates a child's interest and curiosity. This approach often effectively taps or activates learners' pre-existing knowledge while assisting the teacher in fine-tuning instructional content and strategically allotting time to needy areas. Teacher 2 Urban School 2 discussing his attributions to teaching strategies went on to say that:

> *I normally build my lesson from the content of the previous grade. I associate my lesson with their everyday experiences. Whenever I make examples, I make examples of things that they normally see on a daily basis in life and I have discovered that they enjoy the lesson and they also add more relevant examples which I did not expect.*

Linking with the previous grade suggests vertical alignment of content which provides a mechanism that ensures cohesive and consistent, content coverage appropriately linked to standards aligned with departmental assessments (Mukeredzi and Manwa 2019). The approach adopted by Teacher 2 allows teachers to focus on building skills and knowledge while reducing the need for excess review and repetition. From the above responses, the teacher attributed his lesson delivery to learners' previous knowledge and this was confirmed in the lesson

observation of this participant. The lesson that I observed was in Grade 12 and the teacher was referring to Newton's Laws of Motion, a topic covered in Grade 11 (LO 2 Urban School). Teacher 2 further raised attributions related to alignment with learning in the previous grade where the teacher used prior knowledge as an introduction, posing some questions to the learners. Literature surveyed (Mozingo 2017) suggests that teachers should use warm-ups to engage students' interest, activate prior learning and make connections with their knowledge of learning in previous grades. This helps learners to make links and see the relationship between the new and old content which further cements their understanding of new concepts. From theory (Weiner 2005), the learners' prior knowledge is an external attribution which the teacher cannot control but uses as a basis for lesson delivery. The teacher's comments also suggest attributions related to contexts and use of practical contextual examples. Such approaches, as noted by Mukeredzi and Sibanda (2016) in surveyed literature, are essential for creating learning environments in which every learner can thrive. With such attributions the teacher can assess and draw on their contexts and act appropriately given that their professional actions are defined by surrounding circumstances. Drawing from the theory (Weiner 2005) referring to previous content knowledge and giving contextual examples are all internal attributions over which the teacher has total control and which he/she can manipulate for the benefit of learners. Physical Sciences is a practical subject and, as such, when teaching, practical examples are vital to make learners understand. Using such concrete examples when teaching is consistent with surveyed literature (Ramnarain and Hlatswayo 2018) which indicates that how much students learn depends on how much background knowledge they have and that is why teaching facts is necessary.

Sharing his attributions to teaching strategies, Teacher 8 Rural said: *"when teaching Physical Sciences I believe I should capture the attention of learners first, by creating a scenario with a problem related to the topic of the day".*

Teacher 8 attributed lesson delivery to problem solving to engage learners and capture their attention in the introduction. Consulted literature (Ramnarain and Hlatswayo 2018) asserts that good discussion questions get the students' attention and teachers should start by asking a question associated with something learners could have read – not a recall question but one that makes them think critically.

Another attribution to teaching strategies during lesson delivery was the use of acronyms, as explained by another teacher in a FFI:

> *During lesson delivery I use acronyms. The use of these acronyms has helped me to make learners understand better especially progressed learners. I use acronyms to explain some of the concepts like in redox reactions and galvanic cells there is an acronym LEO for Loss of Electrons is Oxidation and GER for Gaining of electrons is Reduction.* (Teacher 1 Township)

From the above, teachers attributed their lesson delivery to the use of acronyms for the benefit of progressed learners. As the strategy was effective this was repeated. Weiner (2005) noted that people are likely to repeat an action if it was attributed to internal causes because they would expect the same outcome as it is stable and controllable. The use of such techniques in teaching Physical Sciences is in line with surveyed literature (Yezbick 2016) which shows that effective teachers use techniques that best serve the learning needs of their learners. Weiner (2005) further noted that such techniques are used so that each student is engaged and challenged to achieve his/her personal best, in other words, to reach their zone of proximal development.

Closely related to the use of acronyms, teachers attributed their lesson delivery to the use of examples to enhance learner understanding. In another FFI, a teacher said that:

> *One good thing about Physical Sciences is that what we teach are the things that we see almost every day. So, a Physical Sciences teacher must have an example of a situation that we see in everyday life that is related to the topic of the day* (Teacher 4 Rural)

Teacher 4 Rural School 4 attributed lesson delivery to contextual knowledge from where he drew examples of daily life situations. He asserted that learners understood Physical Sciences better when examples were driven from their everyday life. Grossman (1990) asserts that teachers must draw on their understanding of particular contexts in which they teach to adapt their more general knowledge to specific school settings and individual students. In other words, a teacher's knowledge, to be of use in classroom practice, must be context-specific, that is, it must be adapted to their specific students and the demands of their schools, communities and districts through use of contextual examples and resources. Further literature surveyed (Fischer et al. 2018) suggests that teaching methods should be inventive, encouraging and beneficial to provide tools that can be applied to the learners' real-life situations. The same notion of attributions related to contexts and use of every example was echoed in a FFI by

Teacher 3 in Urban School 3 who said, *"Whenever I make examples, I make examples of things that they normally see on a day to day in life"*.

The above findings show that some Physical Sciences teachers attributed their lesson delivery to the use of day to day examples to aid learner understanding. From literature consulted (Scott, Asoko and Leach 2007) context-based teaching is expected to improve students' understanding.

Thus, attributions to use of real-life situations in teaching Physical Sciences is thought to increase relevance, student understanding, coherence and student motivation (Scott, Asoko and Leach 2007). This suggests teachers' attributions to lesson delivery were based on learners' everyday experiences and situations. Using acronyms to link new knowledge to learners' previous knowledge were some of the attributions to their lesson delivery that Teacher 1 cited. Informed by theory (Weiner 2005), all the attributions highlighted above were internal.

Three Physical Sciences teachers also attributed their pedagogical strategies to learner ability which influenced their choice of strategy: either group work or individual work. The following comments were made in the three research sites during FFIs for example:

> *...the nature of the content to be done sometimes requires learners to share, that may influence me to group them and sometimes I choose individual work because I want to assess the individual learners' performance.* (Teacher 1 Township School)

The choice of strategy during lesson delivery in Physical Sciences was also attributed to the type of learner activity. In other words, choice of strategy was attributed to the nature and goal of the task. In support of the above Teacher 3 Urban School 3 in a FFI said:

> *In all activities, if I am to use group work, I prefer mixed ability grouping so that those who are weak do not feel segregated. The fast learners will assist the slow learners*.

Teacher 3 at Urban School 3 above attributed the type of grouping to learner diversity where the goal was to get learners to assist each other. However, some literature consulted (Fischer et al 2018) revealed that mixed ability grouping where gifted learners are scattered throughout the classroom may make them feel superior to their classmates and promote arrogance. However, other sourced literature (Mozingo 2017) indicates that mixed ability grouping can be

more frequently used at the beginning of the school year so that learners get to know each other and then used less frequently as the year progresses. In lesson delivery while learner ability according to attribution theory is an external factor to the teacher which is innate and difficulty to change, grouping is an internal attribution which the teacher has total control over (Weiner 2005).

Concomitant to comment by Teacher 3 in Urban School 3, Teacher 5 at Rural School 5 in a FFI attributed choice of ability grouping to level of difficulty of the task: *"in terms of the group work I also consider the level of difficulty of the question. If it is too challenging, I put learners in groups according to ability and I assist the struggling groups".* The main attribution in this grouping strategy was to give more attention to the struggling learners. Literature consulted (Fischer et al. 2018)in support of this attribution shows that through ability grouping teachers can manage a class, engage learners and pace the curriculum better when students have similar cognitive abilities. The grouping strategy is given weight by Weiner's (2005) attribution theory which noted that if one goal of education is to help students develop a realistic appraisal of their own ability (internal factor), students need to measure themselves with appropriate yardsticks and in this case comparisons are more likely to be accurate when made with others of similar abilities. However, this attribution to grouping was challenged by Murphy et al. (2017) in literature consulted who noted that when gifted students are grouped together for instruction, the experience of studying with intellectual peers may actually lower their self-esteem which may negatively impact on their performance.

From the above discussion 16 Physical Sciences teachers attributed their teaching strategies to learners' knowledge, their everyday experience and the use of examples from learners' context. These were some of the external factors teachers in this study attributed their pedagogical practices to. Physical Sciences teachers also attributed their pedagogical strategies to learner ability where they had to choose either group work or individual work. Some teachers used ability grouping while others used mixed ability grouping. Teacher ability to group learners according to their performance is an internal attribution (Weiner 2005) and such skills can change over time. According to attributions theory (Weiner 2005), as alluded to above, attributions are either internal or external. Internal attributions such as ability and effort are controllable whereas external attributions are beyond the teachers' control. Closely related to strategies were learner activities which some Physical Sciences teachers also attributed to.

Learner Activities

12 participants reported attributions to classroom practice around learner activities. Learner activities were the oral and written tasks that learners engaged in inside or outside the classroom which enhanced achievement of educational goals. Literature surveyed (Dunbar 2014) states that learning activities refer to the teacher guided instructional tasks or assignments for students.

Teachers (12) raised attributions to choices of learner activities, for example in a FFI, Teacher 4 Rural, Teacher 8 Rural and Teacher 1 Township pointed out that:

> *In my class activities, learners do a lot of writing because when we are teaching, we are preparing learners for final examination where writing is a must. I believe in at least two activities per day even though the CAPS document says a minimum of three activities per week. I overdo it to give learners more time for practice.* (Teacher 4 Rural)
>
> *I believe in written work, and I strongly believe that learners understand better if they write so I give them more work during the lesson* (Teacher 8 Rural)
>
> *Learners must write during lessons and even if I don't have time to mark but they must write and this helps them to remember. I am of the view that anything written down by learners enhances remembering*. (Teacher 1 Township)

From the above responses, learner activities were attributed to the need for more activities, as well as the need to prepare learners for examinations. According to Teacher 4 in Rural School 4, Grade 12 Physical Sciences learners were supposed to engage in more activities to gain more practice and exposure to previous examination-type questions.

The above finding was confirmed in the document reviews that I carried out for the same participant (DR 4 Rural), where the CAPS policy document required a minimum of three written activities per week. On reviewing learners' exercise books, there were five written activities per week (DR4 Rural) that exceeded the minimum requirement. Borich (2016) from surveyed literature asserts that effective teachers provide students with activities and assessments that encourage them to learn. Learners were given more written work for purposes

of practice. Thus, with regard to lesson delivery Physical Sciences teachers attributed learner activities to the number of activities for learners to engage in and the need to offer them examination practice. This is consistent with theory where Weiner (2005) recommends that instructors should provide students with ample opportunities to practice tasks. In the same vein, literature surveyed (Murphy et al. 2017) noted that if learners practise for the examination they stand a better chance of doing well in that task. Such practices are essential components of learner motivation. However, critics of the expository approach (teaching to achieve a particular goal) from surveyed literature argue that a focus on the examination does not provide learners with opportunities to develop holistically to achieve high cognitive skills as the focus is narrow (Josephsen and Hvidt 2015). Moreover, the South African Education policy on The Minimum Requirements for Teacher Education and Qualifications (MRTEQ) emphasises that teachers must understand their learners' individual needs and must teach them accordingly to achieve a holistic development of learners (DBE Government Gazette: MRTEQ 2015:64).

Concomitantly, Physical Sciences teacher attributions to learner activities in lesson delivery were echoed by Teacher 1 Rural School 1 in a FFI who said:

> *I will engage the lesson by giving them classwork maybe 20 minutes before the end of the period. If time does not permit then I will give them work to do as homework. If it is a class activity, they do it in class under my thorough supervision*.

Physical Sciences teacher attributions to their pedagogy in lesson delivery, indicated that they attributed the learner activity in lesson delivery to the type and nature of activity that they wanted to give. In this scenario, lesson delivery around learner activity was attributed to the nature and objective of the activity. Learner activities were usually guided by a set of questions. Teachers also had their own attributions to the choice of questions. On attributions to the type of questions used in class activities, another teacher in a FFI said:

> *... it is the knowledge of learners and it is the type of questions that are asked in the examination. It doesn't make sense to ask questions that do not frequently appear in the final examination. So, the examination guideline has a great influence.* (Teacher 5 Rural)

According to Teacher 5 Rural School, the choice of questions in classroom activities were attributed to learner ability and type of previous questions. In other words, learner ability and previous question papers determined the questions to be asked.

Closely related to the above attribution, in a FFI another teacher said:

> *Whatever question I ask the learners it must be hovering around my objective. I will ask questions that help me to check if the learners have understood. I also try to ask questions that have once appeared in the examination question papers and also guided by the examination guideline.* (Teacher 4 Township)

Findings from the above participant indicate that as a Physical Sciences teacher they also attributed their selection of questions for classroom activities to lesson objectives and previous examination question papers when engaging learners. As well, such questions would enable them to assess the learners. Consulted literature shows that objectives help students discover how to reflect on their learning and become more active participants in the learning process (Ivy 2013). In this study, the goal during lesson delivery was to expose learners to standard examination questions and, subsequently, objectives were attributions that informed classroom activities.

Supporting the same attribution, Teacher 2 at Urban School 2 during a FFI said:

> *When I throw questions, I also look at the questions that normally feature in the examination. Another factor is the learner's physical responses in the class. As I explain things, learners react, such facial reactions help me to ask questions to check their understanding*.

Findings from Teacher 2 in Urban School 2 show that this Physical Sciences teacher attributed their choice of questions and questioning techniques to previous examination questions and learner responses and reactions to questions, gestures and facial reactions of learners (their non-verbal communication). Often, a frowning face implies that the learner did not understand the concept, while a happy face portrays the opposite and a blank face implies total confusion. From Weiner's (2005) attribution theory, teacher's choice of questions is an internal attribution which is unstable controllable. The theory further indicates that teachers are more likely to stay motivated to try a teaching strategy again in the future if they have attributed the cause of the

original outcome to factors that are unstable controllable. On the other hand, learners' responses and abilities are external factors which the teacher cannot control.

Teacher 4 in Urban School 4 added that:

> *You know, during class activities I direct easy questions to struggling learners. You know there are those low hanging fruits which are those questions that can be answered by any learner. You find that these learners are struggling with these questions, so I give them more work so that they can end up mastering these questions so they can get level 2.*

The response above relates to previous comments on attributions to learner ability and learner diversity in their classrooms. Questions in classroom activities were also attributed to learner ability. Learners who were struggling were given easier questions which the participant referred to as "low hanging fruits" so that they could achieve the required level which is a 30% pass. However, this approach will only produce temporary achievements in the form of a matric certificate but these learners may not qualify for University entry. Despite this limitation, the emerging finding here is that some of the Physical Sciences teachers attributed their classroom pedagogies and learner activities to learner ability and diversity. However, this is contrary to literature surveyed (Taylor 2013) on teacher attributions which shows that teachers tend to call those who they think will know the answers more often than those who they feel will simply provide incorrect response. Also, sourced literature (Saracho 2014) suggests that when a teacher has high expectations for a student, they often develop an interest in that student and focus on improving his/her performance. This implies, then, that students about whom negative perceptions are held are not provided the same pedagogical opportunities for performance improvement.

Physical Sciences teachers attributed their learner activities to previous examination questions, lesson objectives and learner diversity. The next section focuses on classroom management, one of the subthemes.

Classroom Management

In analysing the nature of Physical Sciences teacher attributions to their pedagogy, classroom management also emerged under classroom practice. Teachers have different attributions to classroom management and most of them, according to Weiner (2005), are internal factors

which can be controlled. Classroom management refers to a process of ensuring that classroom activities run smoothly without disruptive behaviour from learners which may compromise effective lesson delivery. Literature consulted (Stough 2013) shows that classroom management refers to the ability of teachers to organise learners and manage their behaviour in order to achieve positive educational outcomes.

16 Physical Sciences teachers reported attributing their classroom management to learner behaviour, explaining that it was the key to a successful lesson. In a bid to create a conducive learning environment in class, Teacher 5 in Rural School 5 during a FFI, explained:

> *I believe that a lesson must be funny, learners must enjoy, learners must learn and learners must be free but being free does not mean you must misbehave but it means you are free to talk, you are free to express your ideas and learners must know that they are protected.*

From the above response, Teacher 5 attributed classroom management to a conducive classroom environment where learners felt free to express themselves and secure a chance to respond. Such learning environments were often a reflection of effective classroom management. The above assertion was confirmed during the lesson observation (LO) that I carried out immediately after the interview. Learners were working in groups, laughing, raising their hands to call the teacher when they needed support (LO 5 Rural). Literature searched (Rubio 2010) indicates that classroom management is better controlled by creating a free environment in class where learners and teachers express themselves freely.

Closely related to this was a point raised in a FFI by another teacher who said that:

> *When I am in front of the learners, I do create jokes. I am not that type of teacher who teaches in a hard way. I do create jokes and you find learners are laughing in class and at the same time learning because that is the business of the day.* (Teacher 1 Urban)

Teachers attributed their pedagogical practices of classroom management to creating a free but conducive atmosphere for learners where they could express themselves freely and the teacher creating jokes. Mukeredzi (2013) in confirmation noted that a conducive learning environment provides a platform devoid of both physical intimidation as well as cognitive and emotional frustration, which allows for a free exchange of ideas where learners learn and laugh together.

Such an environment makes the classroom safe to both the teacher and the learners. Literature consulted shares the above view:

> *Humour can be a powerful ingredient in every lesson. Effective teachers do not need to be clowns, but it is beneficial to have good sense of humour, and be willing to share jokes with the students to break negative-cold barriers.* (Rubio 2010:23)

From the response by Teacher 1 in School 1, the teacher had a good sense of humour and attributed classroom management to a relaxed learning atmosphere where jokes were created and learners laughed and learned. From the theoretical perspective, the ability to manage learners in a class is an internal attribution (Weiner 2005) over which the teacher has total control and this can change depending on the environment. Ivy (2013) from surveyed literature noted that humour can help capture and retain students' attention, it can also reduce stress or anxiety and can promote a sense of acceptance in class that allows students to think in creative and divergent ways.

Ramos and Luzano (2018) from literature consulted identified some good teacher qualities which contribute to good classroom management and among them was the ability of the teacher to encourage an open and trusting learning environment and creating a climate of trust. In addition, the teacher should be able to encourage students to learn from their mistakes by encouraging them to ask questions and engage in the learning process. All these teacher attributes are pillars of classroom management.

In the same vein in a FFI, Teacher 1 in Township School 1 argued that:

> *There must be mutual respect in class. The learner respects me and I respect them, you have to acknowledge that they are humans, as well. Treatment must be the same for all learners. You can't reprimand one learner and leave the other one. I do not want to infringe against their basic rights. Whether it's human, religion or cultural, we need to respect that. At the end leaners also respect you.*

From Teacher 1 in a Township school, an internal attribution to classroom management that emerged was mutual respect and equal treatment for all learners. Attributions related to mutual respect from both the teacher and learners as humans, and sameness of learner treatment by the teacher. As alluded to above, teacher respect towards learners is an internal attribution which

is stable and controllable but learner respect towards the teacher is an external attribution which is unstable but controllable (Weiner 2005). The teacher also made references attributing classroom management to respect for diversity. These attributions are consistent with surveyed literature (Cruickshank and Haefele 2014) which asserts that effective teachers treat their students with respect and expect the same in return, enhancing the students learning progress.

Attributing mutual respect to classroom management was further supported by another teacher who said that: "*In class, I play all the roles you may think of. I am a parent; I am a Pastor to them, I say feel free I am just your equal by so doing, they tend to love me".* (Teacher 8 Rural)

From Teacher 8, an internal attribution to classroom management in the form of loco-parentis emerged. Further, attributing classroom management to a loco-parentis role is supported by Eisner (2012) from literature consulted who suggests that "teaching is a caring exercise" which takes an important role in effective learning process. Showing care often includes listening to the students, not only when they are in the classroom, but also about their particular lives and/or personal problems. The teacher attributed effective classroom management to this attribute. . Literature surveyed (Peacock 2009; Pishghadam and Motakef 2011; Erten and Burden 2014) shows that there is a strong link between the teacher's age and attribution style , in other words age influences teacher attributions of what happens to them in and outside the classroom. Of the 16 participants, Teacher 8 Rural was the oldest (51years) and consequently his attributions and approach to classroom management (loco-parentis) is in tandem with findings from previous studies highlighted above. This internal attribution (Weiner 2005) is in line with South Africa's DBE policy on seven roles of an educator which stipulates that an educator must demonstrate a pastoral role (DBE Government Gazette: The MRTEQ 2015:61) among other roles. Such an internal attribution is stable since the teacher is able to change or modify it over time (Weiner 2005).

In the event that a learner misbehaves in class, two teachers from different sites suggested these strategies to share:

> *Some learners misbehave with the intention of embarrassing you as a teacher in front of other learners, when the learner does that in class, I try to correct it in class there and then and try to be strong and tell the learners that this is not the kind of behaviour I want in my class.* (Teacher 3 Township)

> *To control my learners, I stamp my authority so that they know that when I am in class, I mean business. When a learner misbehaves usually, I get some time to talk to the learner, emphasising that this is not the kind of behaviour that I want and if you insist, I will kick you out or I will inform your parents.* (Teacher 1 Urban)

Teacher 3 Township above attributed effective classroom management to on-the-spot learner discipline and stamping out elements of indiscipline immediately subsequent to its occurrence to avoid disruption of teaching and learning and demonstrate to the whole class that such unbecoming behaviour would not be tolerated. Physical Sciences Teacher 1 Urban attributed classroom management to being firm, making time to speak to the learner and also warning them that for continuous misbehaviour, they would be sent out of class, notwithstanding that sending learners outside was outside education policy as learners miss out on learning while standing outside the classroom. However, literature consulted (Van der Westhuizen et al. 2012) indicated the shortcomings of such a type of management skill asserting that it may result in poor performance given that when learners are sent outside the classroom, their contact time is reduced and they miss valuable class activities. South Africa's DBE policy on the seven roles of the educator views them as leaders, administrators and managers (DBE Government Gazette, 2000). These management roles are given weight by consulted literature (Wong and Wong 2015) which asserts that maintaining discipline is necessary for learning to be effective and learner misbehaviour can be minimised by skilful teaching. Thus, effective teachers often manage their classrooms with efficient procedures and routines while ineffective teachers discipline their classrooms with threats and punishments like chasing them out of class. Furthermore, drawing from Van der Westhuizen et al. (2012), there is a strong link between lack of discipline and poor performance since time is wasted on disciplinary hearing thereby reducing contact time. However, Teacher 3 Township and Teacher1 Urban above, attributed their classroom management to appropriate ways and skills of managing their learners notwithstanding that Teacher 1 warned of sending learners outside in the event of continued indiscipline.

From the attribution theory, if teachers perceive that the cause of misbehaviour is beyond their classroom influence and practice, they are not likely to look for ways in which they can positively change the behaviour and enhance learning (Weiner 2005). From the above, teachers had perceptions that some learners misbehaved with the intention of embarrassing the teacher. If they perceive that a learner is able to control his/her behaviour and learn, when behavioural

problems occur they will presume that the learner has the capacity to change behaviour in some way and benefit from the teaching. Unfortunately, when such perceptions exist teachers often adopt negative approaches (sending learners outside) which may be detrimental to learning (Johansen et al. 2011).

Findings from the theme around classroom practice indicate that Physical Sciences teachers attributed their lesson preparation and planning to the nature and ability of learners, learner diversity, the resources to be used, the examination guidelines and identified common errors in reports, all of which are external attributions. As for lesson delivery, most attributions were internal to the teacher notably the teaching strategies to be used and the learner activities. With regard to classroom practice related to classroom management Physical Sciences teachers attributed class management to learner behaviour, loco-parentis approaches, effective leadership and good management skills which included mutual respect, acknowledging diversity and stamping out indiscipline before it got out of hand. Resources as an attribution came up and was discussed somewhat in brief under lesson preparation and delivery above. This aspect is discussed in detail in the next section.

Teacher Attributions Related to Resources

Another theme that emerged on the nature of Physical Sciences teacher attributions to their pedagogy related to resources. Resources in this study encompass infrastructure, finance, time and materials that support teaching and learning. The unavailability of textbooks, leading to abnormal sharing ratios, lack of apparatus and chemicals to conduct experiments and lack of laboratories in rural schools were the major resource attributing factors to the teachers' pedagogical practices. Physical Sciences teacher attributions around resources are discussed in this section.

Teaching and Learning Material Resources

11 Physical Sciences teachers attributed their pedagogical practices to teaching and learning material resources such as chemicals and models for practical demonstrations. Lesson delivery in Physical Sciences required a variety of resources, especially laboratory equipment and apparatus for demonstrations. In a FFI, in emphasising the importance of laboratory equipment in Physical Sciences, Teacher 7 in Rural School 7 pointed out that: *"When teaching Physical Sciences I enjoy the practical demonstrations and the chemical reactions to prove certain concepts to learners. This is only possible when they are available".*

From Teacher 7 in Rural School 7, practical experiments in Physical Sciences stimulated learning and learners understood better when scientific concepts were demonstrated and proved. Thus, Physical Sciences teachers attributed their pedagogical practices to the availability of scientific equipment. So being a practical subject, resources were vital in the teaching of this subject.

Teacher 3 in Rural School 3 alluding to the issue of resources said:

> *One thing that I do not enjoy when teaching Physical Sciences is the shortage of chemicals to conduct experiments. Also, I do not have enough time to engage my learners in terms of practical activities so I think that's where I do not enjoy teaching Physical Sciences because the shortage of resources is very frustrating.*

Teacher 3 Rural attributed his classroom practice to shortage of laboratory materials and time resources. The shortage of practical apparatus was hampering lesson delivery and a frustrated teacher could not be expected to perform to his best which negatively impacted on the learner. The shortage of resources in rural schools was also confirmed in consulted literature (Makgato and Mji 2006) which noted that many public schools in South Africa lack proper laboratory materials such as chemicals and apparatus which is a challenge to the learning of Physical Sciences. Drawing from Weiner (2005), resources are external attributions to teacher pedagogical practices. Consequently, the teacher has no control over such provisions. As a practical subject, resources are a critical requirement when teaching Physical Sciences because experiments help learners to understand scientific concepts better, which brings about knowledge retention, and experiments are also part of assessment.

I also noted the shortages during Lesson Observations (LO) in all the research sites involved in my study. As well, in Document Reviews (DR) that I carried out, I noted that practical experiments are prescribed in the Programme of Assessment for Grade 12: six practical experiments, three from Chemistry and three from Physics (CAPS Document Reviews from all sites). So, practicals were done in compliance with the policy but without resources, making the teaching of Physical Sciences a challenge. Thus, teachers attributed their pedagogical practices to resource shortages. Therefore, as stated above, this is consistent with the theory (Weiner 2005) which asserts that all external attributions are uncontrollable yet they are key elements in pedagogical practices.

The above challenge was shared by Teacher 2 Urban and Teacher 4 Township who also attributed their pedagogical practices to shortage of resources:

> *The other frustrating aspect is the shortage of models in teaching Physical Sciences, for example, when you want to explain the atom in Chemistry, it's not something that you can see with a naked eye so the learners always want to visualise it. This affects the way you teach. (Teacher 2 Urban)*

> *One thing I do not enjoy about teaching Physical Sciences is lack of resources. We have the laboratory and a few science kits but still they are empty. This affects teaching. The only thing the school can offer are books only and not material like chemicals and other physical sciences aids.* (Teacher 4 Township)

These Physical Sciences teachers attributed their pedagogical practices to resource shortages. Resource shortages were prevalent even in urban schools. Most practicals in chemistry required chemicals and models to make explanations clearer. However, effective lessons were hampered by lack of resources, hence teachers attributed their pedagogies to these shortages. From the Physical Sciences teachers above, teaching a practical subject without adequate apparatus was a futile exercise because learners needed concrete examples to enhance the grasping of concepts. Consulted literature (Ramnarain and Hlatswayo 2018) noted that the implementation of CAPS in Physical Sciences, especially its emphasis on inquiry-based learning, has been frustrated by the shortage of resources in schools which may be contributing to learner failure. Unlike in other research sites, especially rural sites, Township School 4 had some Science Kits but these were exhausted and the challenge persisted. Text books were available but scientific apparatus remained a challenge. While the focus was on Physical Sciences teacher attributions to their pedagogical practices, it was also interesting to note the unequal distribution of teaching and learning resources in different contexts and it appeared shortages were more acute in the rural context and this made the context appear marginalised. Such external factors (Weiner 2005) are uncontrollable.

This challenge was confirmed during the lesson observation that I carried out at the same site. The lesson required demonstrations using chemicals but the participant gave a theoretical explanation due to absence of resources. The science kit had a few iodine solutions and some

methylated spirits which were not relevant for that particular topic (LO 4 Township). Lack of resources (external attribution) in many South African schools was also noted by Umalusi, (the board tasked with quality control in the South African schooling system) in literature surveyed (Grussendorff 2014) where the prescribed practicals in Physical Sciences required specialised apparatus that most schools did not have. Umalusi further noted that due to lack of resources most schools in the country (95%) (Grussendorff 2014) could not implement the practical components in Physical Sciences as required by CAPS. When the teachers are not fully equipped, they become frustrated. As a result of these disconnections between what teachers want and what they are getting, their enthusiasm for teaching goes down and consequently their effectiveness. As such, teachers attributed their pedagogical practices to shortages of teaching resources and drawing from Weiner, (2005) these are external and unstable attributions over which teachers have little or no control in their pedagogical practices. Literature consulted (Pishghadam and Motakef 2011; Erten and Burden 2014) around teacher attributions indicates that age influences teacher attributions. Mature and experienced teachers (such as Teacher 2 Urban) tend to attribute challenges related to classroom practice to both internal and external factors whereas their young counterparts (such as Teacher 4 Township) would attribute all challenges to external factors only. Findings from this study show that both teachers (mature and young) in the face of challenges in classroom practice, attributed their pedagogical practices to external factors.

Still on teaching and learning resources, during lesson observation (LO) in rural schools, three learners shared one text book, squashed together sitting on a two-seater desk (LO 1 Rural). The class activity that they worked on was from the shared text book and some answers were already written in pencil probably by the previous learners (LO 4 Rural). Most learners had no calculators yet the day's topic, based on Physics, had many calculations that required a calculator. In addition, some calculators with undeleted answers were shared (LO 2 Rural). Using textbooks and calculators with answers meant that learners were neither developing problem solving skills nor learning anything at all, and once the answers were removed, this would impact negatively on the learners. From the above findings Physical Sciences teachers attributed their pedagogy to resource shortages which inhibited teaching and learning.

Literature consulted (Legotlo et al. 2002) states that learners' textbook ratio of 10:1 was recorded in most schools, contrary to my observation during a lesson where learners had a sharing ratio of 3:1 and 2:1 (LO1 Rural-LO4 Rural). The situation of text books seemed to have

improved in some schools since Legotlo et al's (2002) study but the issue of equipment for practicals remained a challenge. It seemed the Department of Basic Education had revised the Rural education policy and provisions, hence, the noted improvement on textbook sharing ratio. Renewed interest in rural education had afforded new opportunities for research, policy, and practice as asserted by sourced literature (Biddle and Azano 2016).

From the above discussion Physical Sciences teachers attributed their pedagogical practices to severe teaching and learning material resource shortages. In the teaching of Physical Sciences the dominant resources shortages attributed to were laboratory equipment such as apparatus, chemicals and calculators. Weiner (2005) classifies these as factors outside the teacher's control (external attributions). However, such attributions impact negatively on teacher pedagogical practices and learner learning. Closely related to the teaching and learning resources the next section focuses on physical infrastructural resources.

Physical Infrastructural Resources

Physical Infrastructural Resources in this context referred to buildings within the school premises where structured learning took place. In this study Physical Sciences teachers also attributed their pedagogy to physical infrastructural resource provision. The specific infrastructure that was commonly referred to was the laboratory which accommodated all Physical Sciences apparatus and where all scientific demonstrations and practical investigations and lessons were conducted. The shortage of this physical infrastructural resource was reported as directly influencing teacher practice to which they attributed their pedagogy.

In a FFI with Teacher 5 in Rural School 5, he had this to say:

> *One factor that affects and frustrates my teaching is the number of learners in my class. I have 81 learners who are doing Physical Sciences in Grade 12 and I have two sessions in Grade 12, I also have Grade 10 who are 86 in class and they have to be packed in one room.*

From the above response, the classes were overcrowded and there was likely to be very little interaction with learners and this adversely affected teaching and learning. The finding from this participant shows that Physical Sciences teachers also attributed their pedagogical practice to inadequate physical infrastructure and teacher-learner ratio. The problem of large classes was also noted in surveyed literature (Makgato and Mji 2006) which indicated that the science

learning field is very complex since Physical Sciences involve practical demonstration which is difficult in large classes. The South African Ministerial Committee on Rural Education (2005) in consulted literature highlighted specific challenges faced by rural school teachers such as large classes and under-resourcing. Lack of these immovable resources was a contributing factor that affected not only learner performance at school level but also teacher attributions to their pedagogies (Hugo, Jack, Wedekind and Wilson 2010).

Physical Sciences teachers' attributions to their pedagogical practices related to poor infrastructure especially in rural sites was also noted in consulted literature (Mukeredzi 2017) which concluded that rural areas world wide experience difficulties to quality student achievements due to poor financing, physical and material resourcing. Drawing from Weiner (2005) all these are external attributions which the teacher cannot change.

The above view was shared by Teacher 2 Rural School 2 who attributed their pedagogies to large class enrolments. He said: *"My teaching performance is greatly influenced by the large number of learners in my class"*.

In a lesson observation (LO 2 Rural School 2) of the same participant, there were 52 Grade 12 learners. Such large numbers affect both teacher-learner and learner-learner interactions and engagement in learning activities. Surveyed literature (Marais 2016) asserts that while statistical analysis of results in some parts of South Africa has shown that the teacher-learner ratio has been decreased to an average class size of 35:1 for Secondary schools this was not the case in many rural schools. This factor contributed to teacher attributions of their pedagogies. Surveyed literature (Department of Basic Education 2009) indicates that Physical Sciences educators who teach smaller classes show more positive attitudes to learners and their work and, consequently, improve learner academic achievement compared to those who teach large classes. Therefore, class size remains as one of the teacher's attributions to their pedagogical practices as the choice of learner activities, materials and approaches was determined by the number of learners in a given class.

Attributing pedagogical practices to inadequate infrastructure was also echoed by Teacher 3 in Township School 3 who said that: *"... there isn't a laboratory here and this is contributing to poor results as it affects our teaching".* While Teacher 2 Rural was lamenting large classes maybe due to shortage of classrooms and the still high teacher-pupil ratio, Teacher 3 Township weighed in with a related challenge: the lack of laboratory facility. These challenges are all external attributions (Weiner 2005) which influence their pedagogical practices.

Literature surveyed (Paine 2013) confirms that teaching is characterised by great unevenness as reflected in the above findings where none of the urban schools in this study attributed their practice to lack of infrastructure. Urban schools are often better equipped than their rural counterparts. These differences are supported by Paine (2013) who noted that top ranked schools in urban areas have higher percentages of high-ranking teachers, quality infrastructure and are better resourced compared to schools in rural villages. This was the case in this study where rural schools were severely under-resourced. Lack of these facilities in the schools studied is likely to have greatly compromised the teaching and learning, and teachers attributed their classroom practice to these external attributions: the shortages of infrastructure and materials.

Findings from the above discussion indicate that Physical Sciences teachers, especially those in rural (eight) and township (three) schools, attributed their pedagogies to lack of infrastructure and in particular lack of laboratories. Some teachers also attributed their pedagogies to class sizes as these determined their decisions on materials, methods and learner activities. Contrarily, their counterparts in urban sites attributed their pedagogical practices to the availability of such facilities. From the attribution theory (Weiner 2005) these shortages and the unavailability of resources were external attributions. Having discussed resource-related attributions, the next section discusses learner related attributions.

Teacher Attributions to Pedagogical Practices Related to Learners

In analysing the nature of Physical Sciences teacher attributions to their pedagogical practices, learner factors also emerged as important attributions. This theme is discussed under two sub-themes, namely, family background and attitude towards the subject.

Drawing on the attribution theory (Weiner 2005), attitude towards the subject and family background were external factors which the teacher had no control over and could not change These two sub-themes are discussed below.

Learner Family Background

Eight Physical Sciences teachers attributed their general pedagogical practices to learner family background. Learner family background generally encompasses the learner's relationship, developed through and with other family and community members, which includes aspects like the learners' social development, experiences and economic aspects of the family. These

learners' performance can be attributed to these factors. Consulted literature (Moletsane 2012) noted that the learner's home background, particularly in rural contexts, is characterised by poverty, unemployment, substance abuse and other social ills, and is often used to explain poor performance in assessment in these schools. In other words, poor performance is often attributed to these social ills. In a FFI with another teacher, explaining what he attributed his pedagogies to he said:

> *One of the things that influences my teaching is the type of learners that I teach, some of them are heading families, they come from child headed families some of them do not have parents, they live on their own. They depend on their grandmothers to support them so that they can be able to come to school.* (Teacher 6 Rural)

From the response above, pedagogical practices of Physical Sciences teachers were attributed to learners' family background: some learners were orphans and staying with grandparents. Such learners were likely to be affected emotionally and psychologically which means their school performance was compromised. This view is consistent with literature consulted (Paine 2013) which indicates that most children who live in rural communities have shattered backgrounds and are characterised by families without meaningful employment, single parent households and an increase in the number of children cared for by grandparents. Being orphans meant that buying school requirements could have been a challenge. Teachers had to bear that in mind in their pedagogies. Furthermore, a literature search (Baker and Jones 2005) indicates that there is a relationship between low socio-economic status and poor performance in sciences. Poor performance was not the subject of this study but these issues gave rise to the teacher attributions to their pedagogical practices.

Similar attributions were shared by Teacher 3 in Rural School 3 during a FFI when he said:

> *Most of the learners are from poor family backgrounds and that on its own is a challenge because it is not easy to teach a learner who does not have something to eat at home and also it is not easy to teach a child with such challenging socio-economic problems, you have to bear that in mind.*

Physical Sciences teachers attributed their pedagogical practices to learners' family background inclusive of poverty, abuse and other socio-economic problems. Learners who

came from poor socio-economic backgrounds seemingly faced challenges in class and were likely to have cognitive problems if they were not given attention. Surveyed literature (Dunbar 2014) supports the above finding proclaiming that students in poverty communities were less likely to feel safe in school and spent less time on school work than those in low poverty communities. According to attributions theory, such attributions are external and beyond the teacher's control (Weiner 2005) since he/she has no influence on the learners' backgrounds.

Concomitant to the above, another teacher from a rural site attributed pedagogies to the distances that learners travelled to and from school. Due to poor family background some learners could not afford transport costs: consequently, they walked long distances to school:

> *Most of our learners travel long distances by foot and at times they arrive late. Some of them travel more than 8 kms single journey on foot you know only to find that when they get home, they will be tired and they can't do their homework. All that has to be considered.* (Teacher 8 Rural)

From the response, the teachers (eight) also attributed their pedagogical practices to the challenges faced by their learners who walked long distances which likely affected their performance. Having travelled long distances to school, the learner could not be expected to concentrate the whole day, hence some teachers attributed their pedagogies to such learner aspects. Others attributed their pedagogical practices to learner arrival time. This attribution was raised by Teacher 4 in Rural School 4 who explained that:

> *The challenge that we have is that of late coming because they are travelling long distances because they can't afford to pay for these taxis. The school starts at 7:30 am but you will find that some learners will come at about 08:30 am and you can't ignore them*.

The fact that the teacher confessed that they could not ignore late coming learners indicates attributions to such aspects. These distances are confirmed in consulted literature (Hugo, Jack, Wedekind and Wilson 2010) in a report to KZN Provincial Treasury that rural secondary schools are between 40 and 55km apart: learners travel long distances to the nearest secondary schools as transport is either absent or expensive. The same view is shared by Mukeredzi (2016) in surveyed literature who noted that in rural areas the roads are poor and as a result transport is undependable; when it is available the costs are high, which forces school children to walk long distances.

From the above discussion, Physical Sciences teachers attributed their pedagogical practices to learners' family background with particular emphasis on poor socio-economic status, long distances travelled by learners and learners' arrival time at school. The next sub-theme discussed below focuses on learner attitude towards Physical Sciences which teachers also attributed to their pedagogical practices.

Attitude Towards Physical Sciences

Attitude towards the subject refers to behaviour and feelings learners had towards Physical sciences. 11 participants attributed their pedagogical practices to learners' negative attitude towards the subjects.

In a FFI with Teacher 3 in Urban School, the following point was raised in explaining their attributions:

> *Most learners have a negative attitude towards the subject which makes it difficult to teach them. Physical Sciences goes hand in glove with Mathematics which involves calculations. Every time learners have a bad attitude towards Mathematics that becomes a problem in Physical Sciences more specially in Paper 1 (Physics paper). Some learners are not interested in anything that involves numbers and for some its laziness, you consider all that in your teaching.*

Attributing their pedagogies to learner attitude towards the subject due to the relationship between Mathematics and Physical Sciences was further confirmed by Teacher 4 Rural who said that: *"Physical Sciences is a subject that heavily relies on Mathematics. Learners who have a challenge with calculations also struggle in Physics Paper and they end up losing interest in the subject and your teaching takes that into account*".

From the above participants Physical Sciences teachers (11) attributed their pedagogical practices to learners' negative attitude towards the subject. It emerged that some learners disliked calculations which were part of the subject. Furthermore, learners' negative attitude was compounded by learners' lack of effort which participants termed laziness. As such these teachers took all these aspects into consideration thereby attributing their pedagogical practices to learner attitudes. Many learners tended to avoid Physical Sciences because of fear of the subject and a lack of self-confidence. Drawing from Weiner (2005), self-confidence in learners is an internal attribution which could be controllable by learners themselves. However, since

the focus was on teachers this was an external attribution to the teacher which he/she was not able to control. According to consulted literature (Gough 2014) there is a drop in the number of learners taking Physical Sciences in high school as well as at tertiary level due to this fear which causes lack of confidence.

In a FFI Teacher 7 in Rural School, about his attributions made this assertion:

> *They don't seem to like Physical Sciences as seen by their little work rate because they relax at home and only work at school and that is why in most cases here in rural schools we are always at school on Saturdays, also mornings and evenings*

Findings from Teacher 7 Rural above indicate that Physical Sciences teachers attributed their pedagogical practices to learners' dislike of the subject and lack of effort which forced them to work outside stipulated times. Lack of effort on the part of the learners transferred the pressure to teachers who ended up working even during weekends.

Document Reviews (DR 7) that I carried out with the same participant concurred with the above. Out of six exercise books that I reviewed, three (50%) learners had incomplete work and incomplete corrections with some blank spaces and the teacher's comment was "*Finish your work*!" (DR7 Rural). So, teachers attributed their pedagogical practices to learners' lack of effort. Incomplete work as noted in DR 7 Rural was due to lack of effort on the part of the learner.

More effort in Physical Sciences was required since learners were failing to complete their work. Failure to complete their work, which Teacher 7 Rural attributed to their pedagogical practices, was also highlighted by another teacher who said that:

> *Physical Sciences is a very challenging subject, very challenging, you may try to explain but at the end of the day the learners may still not understand and they end up developing a negative attitude towards the subject. A teacher has to take this into account.* (Teacher 2 Urban)

Assertions from the above participants suggest that some Physical Sciences teachers attributed their pedagogies to the fact that Physical Sciences was a difficult subject. Literature sourced (Duit, Niedderer and Schecker 2014) suggests that in comparison to other learning areas, it was

discovered that Physics was viewed by learners to be more difficult and hostile. Such perceptions could trigger feelings of discomfort and negative attitudes towards the subject.

Findings from the above discussion indicate that teachers attributed their pedagogical practice to learners' negative attitude towards the subject. The negative attitude stemmed from their dislike of calculations associated with the subject. Drawing from Weiner (2005) this is an external attribution which impacted on teacher pedagogical practices. The following section focuses on teacher attributions related to their competence which is the last theme to be discussed in this chapter.

Attributions Related to Teacher Competence

Factors affecting teacher competence in this study referred to issues that influenced the teacher in executing his/her duties in the classroom. In analysing the nature of Physical Sciences teachers' attributions to their pedagogical practices, teacher competency emerged as a theme that was supported by one sub-theme, namely, Subject Content Knowledge (SCK) an internal attribution to be discussed below.

Subject Content Knowledge (SCK)

Physical Sciences teachers (12) also attributed their pedagogical practices to their subject content knowledge. Subject Content Knowledge (SCK) is the facts, concepts and theories that they taught which learners learnt in a specific learning area in a specific grade. In this study it was content knowledge of Grade 12 Physical Sciences as prescribed in the policy document. Literature consulted (Grossman, Wilson and Shulman 1989) asserts that SCK includes knowledge of the subject and its organising structures.

In a FFI with Teacher 6 in Rural School 6, the participant confessed that:

> *To be honest, I am not comfortable teaching acids and bases, a topic in Paper 2. This was taught at high school in the NETAD 550 and it was scrapped and replaced by NSC and now it's back again under CAPS. I did my matric when it was no longer there. At tertiary I just did it but I was not comfortable again. This affects my teaching, I normally request my friend from a neighbouring school to come and teach it.*

Findings from Teacher 6 Rural above indicate that he attributed his pedagogical practice to lack of subject content knowledge. This participant lacked content knowledge of a particular section of Physical Sciences and was supported by a friend. In the process of obtaining collegial support on SCK, the teacher was also supported in General Pedagogical Knowledge (GPK). It is clear that Physical Sciences teachers attributed their pedagogical practices to SCK. Literature consulted (Kaya 2013) asserts that topics on mass and chemical equilibrium are major topics in Physical Sciences and are central in the curricula of many countries but learners and teachers struggle with these topics. Drawing from the theoretical framework, (Weiner 2005) SCK is an internal attribution which the teachers had total control over, and this could change over time. In this case, teachers could make some effort to enhance their mastery of SCK.

Attributing pedagogical practices to SCK was also shared by another teacher in an urban school who said that:

> *There are practical experiments that I avoid because I am not comfortable with, I just explain to learners because I don't want to be embarrassed if the results do not come as expected (laughing)… they will understand* (Teacher 2 Urban).

Teacher 2 Urban above lacked the SCK thereby not covering the entire ATP. From the above response, Physical Sciences teachers attributed their pedagogical practices to SCK. Surveyed literature (Bertram, Mthiyane and Mukeredzi 2013) indicates that lack of SCK among South African teachers is prevalent yet the teacher is regarded as "generic" and capable of teaching anything.

Attributing their pedagogical practices to limited SCK was also shared by another teacher who said that:

> *I enjoy teaching the Physics (Paper 1) topics but to be honest I have challenges with the Chemistry section (Paper 2), even at school I had problems with Chemistry. I am networking with colleagues but I am also doing my own individual study to understand this paper so that I can teach it with confidence* (Teacher 1 Township)

Teacher 1 Township School above also attributed his pedagogy to lack of SCK but was making some effort to change through networking and engaging in studies as this was an internal contribution which he could modify. Consulted literature (Mosston and Ashworth 2013)

observed that if the teacher has limited SCK, he/she will try to avoid teaching any topic related to the area of weakness. An internal attribution (Weiner 2005) such as lack of SCK can be changed with effort because it is stable and controllable.

Lack of SCK in Physical Sciences was also noted in teachers teaching lower grades but the problem would only surface in Grade 12. This view was shared by Teacher 2 in Rural School 2 who said that:

> *The problem is not with the learners but the problem is with us educators because some of these educators do not even teach these sections. Teachers who teach Grades 10 and 11 avoid some topics only to be discovered by the Grade 12 educator and learners fail to master them because of the short time given. So, I have to bear that in mind in my teaching.*

Drawing from Teacher 2 Rural above, some Physical Sciences teachers lacked SCK and this affected their pedagogical practices. In addition, lack of SCK was not only confined to Grade 12 teachers, but it also cut across all Further Education and Training (FET) Grades. Once learners lack the basic concepts at a lower level it becomes a challenge for the teacher teaching the subsequent level, consequently affecting their pedagogical practices. However, since this was an internal attribution it was hoped that with time it would change. This argument is given weight by literature consulted (Appleton 2015) which shows that many primary school teachers avoid teaching Physical Sciences because of a poor understanding of the content and, as a result, they lack confidence to teach it. SCK is an internal attribution which is stable and controllable. Literature surveyed (Appleton 2015) indicates that teachers are likely to change their pedagogies through professional development if they have high personal self-efficacy, hence, teaching attributions have a significant influence on classroom practices.

The discussion above focused on teacher attributions related to teacher competence and it emerged that Physical Sciences teachers attributed their pedagogical practices to SCK which, according to Weiner (2005), is an internal attribution over which the teacher has total control. Some participants (12) acknowledged that they lacked the required content to teach Physical Sciences at Grade 12 level.

Chapter Summary

This chapter discussed the nature of Physical Sciences teacher attributions to their pedagogical practices in answer to Research Question One. The four themes that emerged were: teacher attributions related to classroom practice; teacher attributions on lesson delivery and attributions related to learning resources; teacher attributions related to learners; and teacher attributions related to teacher factors. These were discussed using data generated from face to face interviews (FFIs), document reviews (DRs) and lesson observations (LOs).

In relation to classroom practice, all the Physical Sciences teachers in the three contexts concurred that they attributed their lesson preparation to the ability of learners and the availability of resources which were both external attributions which the teachers had no control over. These teachers also attributed their pedagogical practices to the lesson objectives to be covered which were internal attributions that the teacher had control over. These attributions were common across all contexts. The study found that these teachers attributed lesson delivery to the ability of learners and the teaching strategies to be used which included group work. Since these aspects could be controlled by the teachers they were internal attributions. Group work and learner activities were attributed to learner abilities. The high volume of learner activities that learners were engaged in were attributed to examination preparation and practice which focus, however, deprived them of holistic learning.

With regard to classroom management, all the Physical Sciences teachers attributed this aspect to external attributions such as learner behaviour and good teacher attributes like respect, acknowledging and handling diversity, playing the loco-parentis role and curbing learner indiscipline before it got of hand, all of which were internal attributions. With regard to attributions related to resources, there was a difference in the type of attributions raised. While rural and township participants attributed their pedagogical practices to shortage of resources (external attribution), especially laboratory equipment and consumables, their urban counterparts attributed their pedagogical practices to availability of resources. The major similarity was that, in all contexts, participants attributed their pedagogical practices to large teacher-learner ratio (external attribution). Regarding teacher attributions to their pedagogy related to learner performance, Physical Sciences teachers indicated that they attributed that to learner family back ground and the learners' attitude towards Physical Sciences.

With regard to teacher performance, participants from all contexts attributed their pedagogical practices to their Subject Content Knowledge (SCK) which was an internal attribution.

Drawing on the theoretical framework, the nature of these attributions was a mixture of internal and external factors.

Having discussed the nature of teacher attributions to their pedagogical practices addressing Research Question One, the next chapter discusses and analyses how the Physical Sciences teacher attributions shape their teacher professional growth.

CHAPTER SIX

DATA PRESENTATION AND ANALYSIS:

How Physical Sciences Teacher Attributions Shape their Professional Growth

Introduction

As stated in the previous chapter, the purpose of the study was to explore Grade 12 Physical Sciences teacher attributions to their pedagogical practices in UMzinyathi secondary schools and how these attributions shape their professional growth. The previous chapter presented the findings addressing Research Question One on the nature of Physical Sciences teacher attributions.

Four main attributions emerged in answer to Question One: attributions related to classroom practice; attributions related to teaching and learning resources (external); attributions related to learner factors (external); and attributions related to teacher competence (internal). Findings revealed both external and internal teacher attributions in relation to classroom practice. The external attributions related to classroom practice were learner ability and learner behaviour, while availability of resources, a classroom related external attribution was discussed separately. The internal attributions related to classroom practice were lesson objectives, teaching strategies and good teacher attributes. These four attributions were common across all contexts

This chapter presents and analyses data that addresses Research Question Two:

In what ways do the Physical Sciences teacher attributions shape their professional growth?

Broadly what emerged revealed Physical Sciences teacher attributions shaping professional growth related to their classroom pedagogical practices. In presenting and analysing data and explaining findings for this research question, I draw on Bell and Gilbert's (1996) Aspects of Professional Learning comprising inter-related personal, social and occupational aspects. As highlighted in Chapter Three, the personal dimension is about beliefs, attitudes and values which contribute to and shape the teacher's professional growth. The social dimension, includes relationships between individuals and groups which influence professional learning and growth. The occupational dimension deals with the strong link between theory and practice which are intimately interdependent and these two aspects together enhance professional

growth. I also draw on literature reviewed in Chapter Two to show how my findings relate to existing research.

Following this introduction, I discuss the themes and sub-themes that emerged in answer to the question on how teacher attributions shape their professional growth. I begin by discussing the way attributions shape professional growth related to improvisation. This is followed by how they shape professional growth related to handling learner diversity and finally how teacher attributions shape professional growth in relation to networking. Subsequent to this, I discuss the chapter summary.

Themes and Sub-themes

Like in the previous chapter, data from all sources – face-to-face interviews, document reviews and classroom observations – were presented together because of the broad similarities in responses. Where variations were noted, these were highlighted.

In presenting findings, teachers are identified by codes, for example, Teacher 1 to Teacher 8. Research sites are identified as Rural School 1-8, while Urban and Township Schools are represented by Codes 1-4. These codes were adopted to enhance confidentiality and anonymity. To reduce length of chapters, data generation techniques are coded as follows: face-to-face interviews = FFI, document reviews = DR and lesson observation = LO.

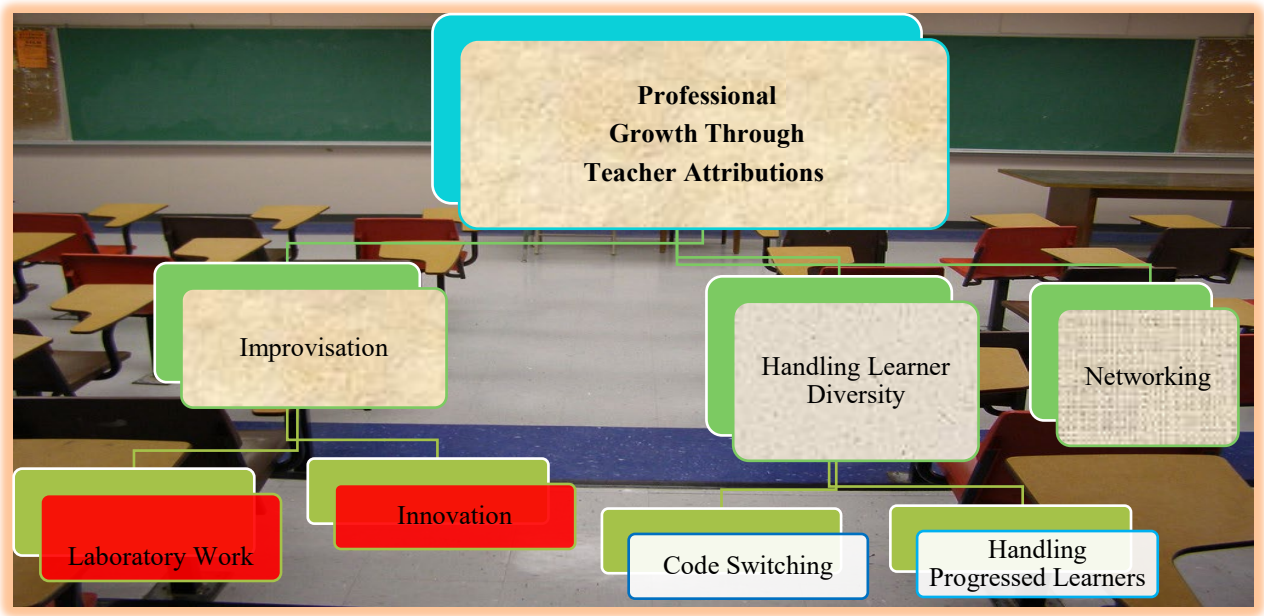
Three main themes addressing Question Two emerged from the data**:** how teacher attributions shaped their professional growth through improvisation; how teacher attributions shaped their professional growth through handling learner diversity and how teacher attributions shaped their professional growth through networking. Table 6.1 reflects the number of participants who made references to particular themes and sub-themes.

Table 6.1 Participants' responses to each theme.

Settings & Participants		Main Themes & their Sub-themes					
		Professional Growth Through Improvisation		Professional Growth Through Handling Learner Diversity		Professional Growth Through Networking	
Sites (Rural, Township and Urban Schools)	**Participants**	Improvisation in Laboratory Work	Innovation	Code Switching	Handling Progressed Learners	Networking with other Educators	
	Total (N=16)	**14**	**13**	**16**	13	16	

It is from this table where figures will be drawn during the discussion in this chapter. A complete table with individual responses is in the appendices (See Appendix Eleven). Figure 6.1 reflects the themes and sub-themes that emerged in answer to the question on influence.

Figure 6.1 Influence of Physical Sciences Teacher Attributions on Professional Growth: Major Themes and Sub-themes.



Source: Researcher 2022

The next section discusses how teacher attributions shaped their professional growth through improvisation. As explained in the previous chapter, attributions are the explanations or reasons that teachers give or have for their or other people's actions, behaviour, feelings or beliefs, skills and knowledge to expose them to relevant teaching and learning experiences (Weiner 2005). In other words, these are the basis for the teachers' classroom and pedagogical choices,

decisions and actions. Attributions are critical to teacher professional practice and growth as they shape their decisions, and choices on instructional behaviours, processes and tasks (Pajares 2003). Thus, teacher attributions to teaching and learning have a great impact on pedagogical practice (Borg 2013) and, consequently, professional growth and students' learning and achievements.

Professional Growth through Improvisation

While teacher learning is generally understood as processes that result in specific changes in the professional knowledge, skills, attitudes, beliefs or actions of teachers', professional growth refers to broader changes that may take place over a longer period of time as continuation of a teacher's professional development beyond their initial training, qualification and induction (Mitchell 2013). Thus, professional growth is the outcome of multiple specific changes accrued through teacher learning and experience which enable them to renew, review and extend their practice, improve or increase knowledge of the subjects that they teach. Literature consulted (Middlewood, Parker and Beere 2013) shows that professional growth is an ongoing process of reflection on one's practices and learning, therefore, leading to development of skills and knowledge. The acquisition of new skills and knowledge may result in teacher change which could manifest in the improvement and implementation of some new or different practices.
As reflected in Figure 6.1 and Table 6.1, teacher attributions emerged as shaping teacher professional growth through improvisation. The influence of attributions related to improvisation is discussed under two sub-themes, namely, improvisation in laboratory work and professional growth through innovation.

Improvisation in Laboratory Work

14 teachers suggested that teachers shaped their professional growth through improvisation in laboratory work (internal attribution). Drawing from Weiner (2005), an internal attribution such as the ability to improvise is within the teacher, it is controllable and can change over time. Such flexibility allows for teacher change and, consequently, professional growth. From Bell and Gilbert's (1996) aspects of professional learning, such skills stem from the occupational domain which emphasises that professional growth is a product of the infusion of theory and practice. In this study improvisation in laboratory work refers to the Physical Sciences teacher attributions related to their ability to out-source some relevant material for practical experiments and demonstrations in the laboratory for lesson delivery where there were

shortages. In the previous chapter teachers attributed their planning and teaching strategies to lack of Physical Sciences equipment (external attributions) which eventually affected their pedagogical practices. In the Trends in International Maths and Science Study (TIMSS) for Grade 8 learners, South Africa scored the lowest in science, coming position 50 out of the 50 participating countries (Taylor 2013). One of the attributing factors to that problem was primarily the lack of exposure of learners to practical work in schools.

Explaining attributions to professional growth through improvisation in laboratory work Teacher 6 Rural and Teacher 2 Township in FFI pointed out that:

> *Some of the apparatus are not enough for individual learners to engage themselves so I end up doing the demonstration myself. I have been doing this for the past six years since joining this school and I am now used to it and I know what to emphasise.* (Teacher 6 Rural).

> *There is no laboratory here and the results are very poor. I have been struggling for a number of years now but then I started to have good results because I am now improvising.* (Teacher 2 Township).

Findings from the above responses show that limited laboratory resources (external attribution) forced Teacher 6 Rural to improvise (internal attribution) by doing the demonstrations on behalf of the learners. He further emphasised that he had been doing that for a long time and this seemingly made him grow and become aware of the grey areas to emphasise. Similarly, Teacher 2 Township, while lamenting the shortage of resources, had seemingly professionally grown and started improvising which he believed had led to producing good matric results. However, while it may not be disputed that teacher improvisation and effectiveness (internal attributions) may have enhanced the school results, it may also be argued that other factors such as improved resources, learners' personal efforts, leadership and others may have played a role in raising the results. Borrowing from the assumptions of social constructivism theories (Vygotsky 1978; Bandura 1978; Kim 2001) learning is a social process, hence, may not depend solely on teacher effectiveness. In a clear disregard of attributing learner achievement to a single factor such as teacher effectiveness, research (Khumalo 2014) identifies a list of factors to that effect such as classroom conditions, learner ability, age, learner focus and others as contributing to learner achievements besides teacher effectiveness. Be that as it may, that ability to work with limited resources which is an internal attribution, suggested professional growth on the part of the teachers through improvisation. Therefore, while Teacher 6 Rural's

external attributions shaped professional growth around improvisation (which was internal) in laboratory work and he/she seemed to have acquired new knowledge and skills, the learners remained passive observers and recipients of knowledge. However, besides the observed limitations, this action of demonstrations in practical experiments was in the occupational dimension of professional growth (Bell and Gilbert 1996) where proponents stress that teacher growth is enhanced by their ability to integrate theory and practice, as was the case in improvisation. Bell and Gilbert further point out that teacher professional growth acknowledges the view that growth can take place in all the fields in which the teacher participates, such as in classroom activities or in any school environment.

Gradual adaptation to practical demonstrations for the benefit of learners suggested acquisition of new knowledge. Literature surveyed (Wickham 2013) shows that demonstrations can be very effective for illustrating concepts in class and the use of everyday objects is especially effective as they require little preparation on the part of the teacher. However, other literature consulted (Vhurumuku 2011) criticised the use of demonstrations arguing that they are teacher-directed and manipulated with limited skill development on the part of the learner. So, what this implies is that science students are required to acquire new knowledge by constructing and investigating for themselves as opposed to memorising facts from teacher demonstrations. Moreover, teacher demonstrations position learners as passive participants and recipients of information.

Explaining how attributions shaped their professional growth through improvisation in laboratory work Teacher 4 Rural during a FFI said:

> *Using simulations has greatly helped me. The science kits which we have are not fully equipped to demonstrate all the different types of experiments, lucky enough we have access to internet where we manage to download some simulations. I am now using these simulations in place of actual practicals. Learners watch these simulations and they understand better instead of theorising in class.*

Due to limited laboratory resources Teacher 4 Rural's internal attributions shaped his professional growth through improvisation and the use of simulations in laboratory work. While under-resourcing was an external attribution, it gave rise to internal attributions – simulations (Weiner 1986) – given that the teacher could control whether or not to use them.

The use of simulations helped the learners to see some of the processes and how they were carried out which enhanced understanding. Further, for Teacher 4 the internal attributions gave rise to capitalising on the internet at the school to use alternatives in teaching Physical Sciences practicals, which shaped his professional growth. Thus, instead of lamenting on the shortage of resources – the external attributions – through his internal attributions, he decided to use simulations which enhanced his professional growth. Limited resources pushed Teacher 4 Rural to be innovative and learn to find other means of teaching Physical Sciences practical experiments. Literature reviewed (Villegas-Reimers 2003) indicates that one of the indicators of teachers' professional growth is the teacher's ability to display knowledge and skills on how to utilise technology in their classroom practice for the benefit of learners. Arguing in favour of simulations, Honey and Hilton (2011) in surveyed literature noted that simulations provide visualisations of phenomena, happening in a large area, which contribute to learner understanding. The same researchers further point out that scientific simulations can assist learners to cultivate rich theoretical understanding, particularly for understanding the behaviour of molecules in chemistry. Therefore, incorporating simulations – internal attribution – in his pedagogical practice Teacher 4 Rural managed to shape his professional growth around improvisation in laboratory work. While from the theoretical framework (Bell and Gilbert 1996) these were occupational aspects, the impetus to learn originated from the personal aspect and its development was probably encouraged by the teacher‘s attitude. The teacher's 'ownership' of this learning opportunity can be distinguished as a significant motivator, while choice to use simulations and control in determining engagement with such learning opportunities is critical. However, further literature consulted (Chen et al. 2014) shows some weaknesses of simulations, such as teachers' lack of simulation experience which may hinder the success of the learning and teaching and also that learners can focus on superficial instead of significant parts of simulations. However, despite these limitations, Teachers 4 and 6 Rural and Teacher 2 Township were able to improvise successfully which shaped their professional growth.

The idea of improvising in case of shortages – external attribution – during laboratory work was shared by Teacher 5 Rural during a FFI:

> *Resources are scarce here, but as a Physical Sciences teacher I have to be innovative and use any relevant tool to demonstrate. One good thing about Physical Sciences is that, what we teach are the things*

that we see almost every day. Physics and chemistry are everywhere so I use what I see to demonstrate, especially in Physics.

Teacher 5 Rural lamented the shortage of laboratory resources. However, this under-resourcing shaped his professional growth through improvising in laboratory work by using other relevant objects to clarify his point. Mukeredzi (2009) discovered that classroom practice challenges (in this case under-resourcing) lead to disturbances which create force and drive for change and development as individuals contemplate innovative solutions. This seems to have been the case with Teacher 5 Rural. The ability to demonstrate and drive the concept home using unprescribed apparatus shows that the teacher was professionally growing. Teacher 5 Rural also highlighted innovativeness which, according to Mukeredzi (2016), encourages the teacher to explore, research and use available tools and materials to uncover new knowledge or to drive a point home. She noted that it involves different ways of looking at problems and solving them which enables teacher professional growth as it compels them to use higher levels of thinking to solve those instructional problems.

For Teacher 5 Rural, this strategy was apparently effective given the rural location of his school. Literature surveyed (Kennedy 2016) asserts that the most effective form of teacher professional growth is the one which takes place in the school context related to the daily activities of teachers and learners. From a theoretical view (Bell and Gilbert 1996), the ability to improvise is a personal dimension of teacher learning which involves an interplay between theory and practice. In this context, the personal dimension was obliged to fulfil an occupational dimension. The teachers believed that through improvisation, the learners would be able to learn and understand better in the absence of apparatus in laboratory work. This, consequently, contributed to and shaped their professional growth.

In this section, Physical Sciences teacher attributions influenced them to rely on demonstrating experiments for learners in laboratory work which shaped their professional growth around improvisation (internal attribution). The professional growth emanated from under-resourcing, i.e., lack of laboratory apparatus (external attribution). Other teachers, in the absence of laboratory apparatus (external attribution) to conduct experiments, were able to use simulations (internal attribution) and became innovative in using other relevant available materials to enhance learner understanding. This promoted their professional growth. What this suggests is that both external attributions and internal attributions shaped Physical Sciences professional

growth. Physical Sciences teacher attributions also shaped their professional through innovation which is discussed below.

Professional Growth through Innovation

13 Physical Sciences teachers indicated that their attributions shaped their professional growth through innovation (internal attribution). Innovation in this study was about developing new professional knowledge and bringing in new teaching approaches in the face of limited resources. Literature consulted (Petrie 2013) views innovation as the introduction of new teaching ideas, methods or devices. The next section discusses how Physical Sciences teacher attributions shaped their professional growth through innovation (internal attributions).

In a FFI with Teacher 5 Rural, he explained how attributions shaped his professional growth through innovation when he said:

> *I have 81 learners who are doing Physical Sciences in Grade 12 and I have two sessions in Grade 12. I split them into two groups of approximately 40 learners then further divide them into smaller groups of 10 and then I identify one faster learner in each team to assist others and I move around monitoring and emphasising key aspects. This has helped me a lot in handling large classes*.

Findings from the response above show that teacher internal attributions shaped professional growth through innovation in the face of challenges. To solve the problem of large classes the teacher was innovative: he sub-divided the class into small manageable groups. The teacher further showed innovativeness as he utilised the abilities of more able learners to assist their peers. All this from Bell and Gilbert's (1996) theory was within the occupational domain of professional learning. Literature consulted (Zenda 2020) indicates that one of the outstanding concerns in the education system of South Africa related to teaching and learning, which has a bearing on teacher professional growth is the issue of large classes in public schools. Such large classes (external attribution) meant that the teacher would have challenges, as classroom communication was often one way and learners tended to become inactive or restless as the lesson proceeded. However, Teacher 5 Rural was innovative, splitting such a large class for the benefit of learners. The teaching and learning of Physical Sciences like all other subjects is expected to be learner-centred with learners engaging in hands-on activities (Levitt 2002) but with a large teacher-learner ratio this may turn out to be practically impossible. Consulted literature (Cortes, Moussa and Weinstein 2012) indicates that class size affects both teacher

and learner performance, consequently, teacher growth, owing to disciplinary problems associated with large classes.

How teacher attributions shaped teacher professional growth through innovation in the face of large classes was also explained by Teacher 8 Rural who said:

> *I split my class into smaller groups for practicals and then do the demonstrations myself since the class is too big. This means I repeat the same demonstration several times but to different learners. I have discovered that after each demonstration there is always an improvement in terms of holding apparatus and explanations and this has helped me in producing good results.*

In the case of Teacher 8 Rural the external attribution – big class size – shaped his professional growth through innovation to solve the equipment shortage problem by doing the demonstrations to manageable groups of learners. The teacher acknowledges that the shortage of resources (external attribution) was a challenge but, notwithstanding, it shaped his professional growth by creating space for innovation. Repeating the same demonstration several times increased teacher professional growth as it enabled identification of areas to lay emphasis on. Surveyed literature (DoE 2009) indicates that Physical Sciences teachers teaching smaller classes, exhibit more positive attitudes to learners and their work, therefore, allowing more space for professional growth, as compared to their counterparts teaching larger classes. Furthermore, consulted literature (Institute for Science Education in Scotland 2005) shows that when teaching sciences, teacher classroom choices, lesson control and learner engagement (internal attributions) provide opportunities for personal professional growth.

From the theoretical perspective, Bell and Gilbert (1996) advocate that the motivation for change originates within the personal aspect of professional learning which may affect the occupational aspects, which was the case in this scenario. The ability to be innovative and handle large classes and deliver an effective lesson was driven by the teacher's attitude and values (internal attribution). The belief that regardless of the class size, learners would still benefit, provided fertile ground for teacher professional growth and change. This, according to Bell and Gilbert (1996), is the personal aspect of professional growth.

From the above discussion, Physical Sciences teachers' external attribution – absence of proper laboratory apparatus – shaped their professional growth through innovative improvisation where demonstrations were held to smaller groups. Another external attribution – large classes

– shaped teacher professional growth through splitting the large class into smaller more manageable groups during demonstrations. Thus, the external attributions, (lack of apparatus and large classes) including the internal attributions (innovation and splitting classes) shaped Physical Sciences teachers professional growth.

Taking from the above discussion, the external attribution lack of apparatus and large classes which affected their pedagogical practices shaped the Physical Sciences teachers' professional growth through improvisation and innovation (internal attributions) in the face of challenges. The above observation is given weight by surveyed literature (Serdyukov 2017) which emphasises that for teachers to be able to survive the demands, threats and challenges within the diverse circumstances of teaching, they need to be persistent, flexible and innovative on new teaching approaches and be prepared in the case of failure. Drawing from the attribution theory (Weiner 2005), innovation is an internal attribution and the teacher has total control over it, which gives them room for professional growth. From Bell and Gilbert's (1996) model of professional learning, this is a personal dimension in which the teacher's beliefs, attitude and values are key factors in professional growth but eventually intended to benefit the occupational dimension, i.e., effective classroom practice. The next section focuses on professional growth through handling learner diversity.

Professional Growth through Handling Learners

In the previous chapter, Chapter 5, classroom management was attributed to Physical Sciences' teachers' pedagogical practices. This chapter discusses how teacher attributions shape their professional growth through handling learners. This is discussed under two sub-themes: professional growth through code switching in teaching Physical Sciences and professional growth through handling progressed learners. These sub- themes are discussed below.

Professional Growth through Code Switching in Teaching Physical Sciences

All 16 participants in this study acknowledged that their attributions (internal) shaped their professional growth in relation to pedagogical practices through code switching when teaching Physical Sciences and this worked positively for them. In other words, their internal attributions shaped professional growth around their instructional pedagogy. Thus, using English as a language of teaching and learning (LOTL) which was attributed to Physical Sciences teachers' pedagogical practices shaped their professional growth. Code Switching (CS) according to literature consulted (García and Otheguy 2019) is the alternating use of two or more linguistic varieties in a sentence in the development of a speech. English is used as a language of

communication in teaching Physical Sciences. Teachers indicated that they had problems in teaching some concepts using English because learners were failing to understand (external attribution), therefore, they resorted to CS when teaching. With reference to the attribution theory (Weiner 2005), CS is the teacher's choice which is controllable and, therefore, is an internal attribution adopted by teachers which may have shaped their professional growth. In other words, through CS Physical Sciences teachers managed to shape their professional growth related to the use of English in Physical Sciences pedagogy. This section will, therefore, discuss some of the methods of communication (internal attributions) employed by the Physical Sciences teachers which shaped their professional growth in cases where English was a barrier (external attribution).

In a FFI, Teacher 7 Rural and Teacher 4 Township had this to share:

> *When I teach my Physical Sciences, I use English mostly. I do code switching when learners fail to interpret questions. They struggle to write long answers. But at times when I need to give practical examples, I am tempted to do so in IsiZulu so that learners understand. I have been doing this especially when I am teaching the Physics section which involves calculations and this has been working positively for me.* (Teacher 7 Rural)

> *If I discover that learners are struggling to understand me when I am using English, I quickly use their home language to clarify the point. This approach has been working for me especially with struggling learners.* (Teacher 4 Township).

As a solution to assist learners who struggled with understanding Physical Sciences concepts in English, the teachers used the learners' home language (IsiZulu). The teachers' responses above acknowledged professional growth related to the use of CS which they indicated improved their pedagogical practices and, consequently, professional growth. Consulted literature (García, Johnson and Seltzer 2017) on CS in pedagogical practices noted that the use of multilingual pedagogies in schools assists learners in understanding concepts. These authors further suggest that an effective teacher who is willing to develop can take a concept that is complex and teach it in a way that can be easily understood by learners through different verbal and non-verbal communications. The fact that the participants had been doing it for some time suggested that it was an approach which they had become used to. This, according to Bell and

Gilbert (1996), is a personal dimension which shapes teachers' professional growth but at the same time enables achievement of the occupational dimension because the teacher believed that learners would understand through the use of their home language. The multilingual approach is informed by social-constructivist learning theory (Swain, Kinnear and Steinman 2015) which advocates for quality interactions, collaboration and learner participation, as was the case in this scenario. The theory asserts that teachers assist learners to develop knowledge through scaffolding strategies including contextualising speech and using the learner's home language to enhance understanding.

Proponents of CS from surveyed literature (Madonsela 2016 and García, Johnson and Seltzer 2017) claim that it has great possibility for assisting the bilingual teacher to achieve teaching and learning goals like clarifying difficult concepts and can lead to enhancement of understanding and cognitive development of both teachers and learners. Therefore, in line with the above, attributions (both internal and external) of Teacher 7 Rural and Teacher 4 Township acknowledged that language shaped their professional growth around the use of CS. This was also in line with Bell and Gilbert's (1996) personal and occupational dimensions.

However, critics of CS from consulted literature (Johnson and Seltzer 2017) argue that it is an indication of linguistic deterioration or an approach used by teachers to compensate for their own weaknesses, as some teachers may misinterpret the word or phrase which may confuse the learners. From this view, while the teachers achieved personal and professional growth, the learners were bound to struggle in the face of an examination because no one would be there to interpret the questions. Another negative aspect of code-switching is miscommunication and misinterpretation which could lead to a teacher being offensive to learners if a phrase or sentence is used incorrectly and, thus, diminishing the professional relationship between students and teachers. In addition, such CS approaches are only effective when all learners are from the same mother tongue background or when the teacher can speak mother tongues of all learners in the class for him/her to switch from one to the other in explaining. However, notwithstanding the criticisms levelled against CS, teacher professional growth was attained, bearing in mind that it was essential for instructional effectiveness and for the improvement of learner learning and achievement. In terms of professional growth, Villegas-Reimers (2003) emphasised that teachers who intend to learn must have good knowledge of the learners' social and linguistic backgrounds.

To dilute the above criticism against CS, literature consulted (Barrett and Bainton 2016) shows that studies in Mathematics and Science teaching in multilingual settings have indicated a great improvement in learner understanding where teachers were using English, alternating it with learners' home language(s). Hence, if properly executed, as was done by Teacher 7 Rural and Teacher 4 Township, CS can help in shaping Physical Sciences teachers' professional growth and learner learning.

The problem of the language barrier was shared by Teacher 1 Urban in a FFI when he said:

> *Since English is a barrier for progressed learners, I always advise them to concentrate in sections that require one-word answer as per examination guidelines as well as calculations since they can't express themselves well in questions that require explanations. Yes, at times you are tempted to teach in their home language for examinations since this is Grade 12.* (Teacher 1 Urban).

Attributing CS to professional growth, Teacher 1 Urban assisted progressed learners to interpret questions using their home language. Progressed learners, as highlighted in the previous chapter, are learners who are progressed to the next grade not because of merit but because of their age and number of years spent in the phase. In assisting these progressed learners, the teacher focused on questions requiring short answers. This according to Bell and Gilbert (1996) is the occupational dimension which includes a strong connection between theory and practice to improve professional growth. In this case the teacher wanted learners to understand concepts and, thus, modified the practice by using short answer questions. A detailed section related to progressed learners will be dealt with in the next section.

From the above discussion, Physical Sciences teacher attributions to their pedagogical practices related to CS (internal attribution) suggested acquisition of new knowledge which probably shaped their professional growth. Having noted that English was a barrier (external attribution) when teaching Physical Sciences, they adopted CS to explain some complex concepts in both Chemistry and Physics. For progressed learners who had challenges in writing long answers (external attribution) the teachers concentrated on short answer responses as per examination guidelines. How Physical Sciences teacher attributions shaped their professional growth through handling progressed learners is discussed below.

Professional Growth through Handling Progressed Learners

13 Physical Sciences teachers attributed their pedagogical practices to progressed learners (external attribution). It was noted that these types of learners affected teacher performance since they struggled to understand concepts, notwithstanding that they were in the same class with the other learners who were fast to grasp concepts. In a FFI, Teacher 4 Rural explained how his attributions (internal attributions) to pedagogical practices shaped professional growth through handling progressed learners saying:

> *Yes, progressed learners are struggling to understand the concepts but at the same time they need more help. So, what I normally do is that, I have a special group for them so that I drill them slowly and focus on those low hanging fruits and these are easy questions and emphasise on how they should present their answers*.

Given that progressed learners were slow learners, Teacher 4 Rural suggested that they were to be given easy questions which matched their cognitive capability. Furthermore, he grouped them together and taught them at a slower pace (internal attribution) to make sure that they understand. These approaches emanating from his internal attributions shaped his professional growth. Literature surveyed (Petrie 2013) indicated that teachers with internal attribution styles put more effort into their pedagogies, such as teaching low performing students (progressed learners). In contrast, teachers with external attribution styles are more likely to ignore these low-performing children and cease their attempts to help them. What this may imply is that while teachers with internal attribution styles may make efforts to learn and, therefore, professionally grow, in teaching low achieving students, teachers with the external styles are not likely to grow professionally in this regard. However, as internal attributions are propelled by beliefs and attitudes, Bell and Gilbert's (1996) personal dimension of professional development supports the idea that teachers with internal attribution styles grow professionally.

Further, in attributing professional growth to handling progressed learners, another teacher in a FFI said:

> *I have learnt that progressed learners need patience. Progressed learners lack confidence and they believe that Physical Sciences is difficult and they quickly give up. I persuade them to attend regularly and I also give them low order questions as a way of boosting their confidence and praise them when they answer correctly. Moreover,*

with high order questions I explain first then give them a few questions with not more than 5 marks per activity because if you overdose, they lose confidence and end up dropping out of school. (Teacher 4 Urban)

Teacher 4 Urban attributed his professional growth to handling progressed learners. Having noted that learners were not the same he gave them different treatment. He, therefore, gave them less challenging questions so that they could build confidence. Realising that there was at least something that they knew in Physical Sciences would keep them in school instead of their dropping out. In addition to the degree of difficulty, they worked with fewer challenging questions which the teacher assisted them in answering. This is consistent with literature consulted (Janes 2021) which suggests that teachers influence learners' cognitive growth and school achievement not only through explicit strategic instruction but also through overt messages about their perceptions of children's abilities and their attribution theories about other factors that influence achievement. From the attribution theory (Weiner 2005), if a teacher attributes failure to some uncontrollable cause such as ability, he or she is more likely to help and praise the student, which is what Teacher 4 rural was doing. Again, such personal beliefs and attitudes will help the teacher in growing professionally (Bell and Gilbert 1996).

Teacher 4 Rural in a FFI also indicated that his attributions shaped his professional growth in relation to handling progressed learners when he said: "*I have learnt that progressed learners work better if they are working amongst themselves. I don't mix them with fast learners. They even explain better to their colleagues and this saves time on my part"* (Teacher 4 Rural). While this approach to teaching Physical Sciences gave progressed learners the chance to develop solutions to problems on their own and also allowed them to play an active role in instructional activities, this shaped the teacher's professional growth. In support of ability grouping, attribution theory (Weiner 2005) asserts that one of the goals of education is to assist learners to develop a realistic appraisal of their own ability (internal attribution) by comparing themselves with others of the same ability which, consequently, increases their performance. Literature surveyed (Fischer et al. 2018) further asserts that ability grouping enables teachers to manage large classes, engage learners and pace the curriculum better (internal attributions) which may enhance professional growth. On the other hand, ability grouping raised by Teacher 4 Rural is also criticised as it has connotations of labelling. In addition, literature consulted (Murphy et al. 2017) further shows that grouping learners according to their ability during instruction may actually lower their self-esteem which may negatively impact on their academic performance.

However, apart from the above criticisms against ability grouping, the teacher's internal attributions related to catering for progressed learners in class suggests that the teacher was accommodative and professionally growing. Literature searched (Gurney 2017) indicates that effective teachers who are willing to grow really believe that all students can learn and succeed, although all understand concepts differently. Such beliefs and attitudes (Bell and Gilbert 1996) related to the personal aspects stemming from gradual acquisition of knowledge and professional growth.

Therefore, from the above discussion, Physical Sciences teacher attributions related to handling progressed learners (internal attribution) seem to have stimulated and shaped their professional growth. Their ability to assist such leaners (internal attribution) in Physical Sciences by assigning them to do easier activities, grouping them separately from the fast learners and then assisting them, was a positive practice that could lead to professional growth and consequently teacher change. Such attributions suggest professional growth in classroom management since these progressed learners felt accepted.

From the section above, Physical Sciences teacher internal attributions shaped their professional growth in handling of progressed learners through ability grouping and giving them more attention, generally giving them less-challenging questions with fewer complex ones, and assisting them in answering those questions to develop their confidence and help keep them in school rather than prompting their dropping out of school.

Findings from this study also indicate that Physical Sciences teacher attributions also shaped their professional growth through networking with other educators. The following section, therefore, focuses on networking.

Professional Growth through Networking

All 16 teachers in this study indicated that their attributions shaped their professional growth through collegial networking at different levels. Networking which shaped their professional growth involved engagement and sharing of content and pedagogical skills within the school, the cluster or the district. In this study networking represented an internal attribution (Weiner 2005) adopted by Physical Sciences teachers where they requested for support from colleagues in the face of challenges. This shaped their professional growth. From the previous chapter, it emerged that some Physical Sciences teachers attributed their classroom practice to lack of subject content knowledge (SCK) (internal attribution). Therefore, in this section, the

discussion focuses on how these teachers used networking to overcome lack of SCK which shaped their professional growth.

In a FFI Teacher 3 Rural, Teacher 1 Urban and Teacher 6 Rural had this to share:

> *For the topics that I am not comfortable with, I invite other teachers from my cluster to come and teach while I observe especially the Topic on Acid and Bases in Chemistry. I have since mastered the content and adopted their teaching approach and its working for me.* (Teacher 3 Rural)

> *We have a District "WhatsApp" group where we share class activities and Formal Tasks. I have learnt to set my own standard tasks copying from the ones posted on the group. Before the birth of this group, most of my Formal Tasks were rejected during moderation but now I am comfortable.* (Teacher 1 Urban)

> *Our cluster is made up of six schools and every year before Trial examinations we combine learners in one venue then teachers with marking experience will then drill the learners in preparation for the examinations. I have learnt a lot from these camps.* (Teacher 6 Rural)

Networking through social media at district level as pointed out by Teacher 1 Urban helped improve on the quality of activities administered in formal assessment which shaped their professional growth. The standard and quality of work was poor before networking: later, the teacher acknowledged the benefit of networking, suggesting professional growth. Closely related to that, Teacher 6 Rural also acknowledged that attributions related to networking shaped their professional growth. Observing experienced teachers drilling learners for examinations enabled acquisition of new knowledge and, therefore, professional growth: '*I have learnt a lot from these camps.*' With reference to professional growth in this study, *'a lot*' could be a pregnant term encompassing such professional knowledge as PK, including classroom management, SCK and PCK among others. In the literature consulted, professional growth through networking is supported by Gupta, Kaushik and Garg (2004) who assert that such facilities cultivate further opportunities for learning and competence development. Consequently, in this study, Physical Sciences teacher attributions related to networking as pointed out by Teacher 1 Urban and Teacher 6 Rural could have also enabled change and professional growth. Proponents of networking and collaboration such as McDonald and Klein

(2013) in literature consulted noted that such avenues in the educational corridors are important in facilitating acquisition of new knowledge in line with the new global environment, promoting creativity and improving the general quality of education. In addition, literature consulted (Jimoyiannis 2010) suggests that teachers' knowledge of Science can be cultivated by engaging teachers in realistic activities which involve learning from peers. In this study, attributions related to networking led to acquisition of new knowledge by the Physical Sciences teachers which probably resulted in professional growth and, consequently, teacher change.

Networking at school level was highlighted by Teacher 4 Township in a FFI. He shared this:

> *This is my second year teaching Physical Sciences in Grade 12 and therefore I have little experience at this level. My advantage is that my Departmental Head (DH) is a Physical Sciences teacher and whenever I have a challenge with a topic or conducting an experiment I request her to come and assist me. She is very experienced and supportive. I am now developing confidence in teaching Grade* 12.

Findings from the above indicate that Teacher 4 Township was networking with his Departmental Head (DH) at school level to overcome challenges related to both content and methodology in Grade 12 due to his lack of experience. It was through networking that he developed confidence. In this scenario confidence is a by-product of networking (internal attribution) which could have given rise to professional growth. Drawing from the theoretical perspective (Bell and Gilbert 1996) this is in the social dimension, which stresses that the relationships between individuals and groups are key to professional learning and growth. This is in line with literature surveyed (Middlewood, Parker and Beere 2013) which shows that it is through networking and collaboration that those involved in the system can exchange views and information and learn from and with each other. Furthermore, it is through networking that teachers remind each other of their roles and pedagogical practices and improve their lessons and their interaction with learners (Hargreaves 2010).

In this section Physical Sciences teachers networking, an internal attribution, shaped their professional growth. Findings indicate that networking was prevalent at school level, at cluster and district levels. It was also noted that through networking Physical Sciences teachers developed in various aspects of professional knowledge such as SCK, PK and PCK including classroom practice and classroom management, thereby shaping their professional growth. From the attribution theory, this type of attribution is flexible, controllable and unstable since

it can change over time (Weiner 2005). Those three indicators (flexibility, controllability and instability) promote teacher professional growth which, consequently, fosters teacher change.

The following section presents the chapter summary.

Chapter summary

This chapter attempted to answer Research Question 2: *In what ways do the Physical Sciences teacher attributions shape their professional growth?* What broadly emerged is that Physical Sciences teacher attributions influenced teacher professional growth in relation to classroom pedagogical practices as has been discussed in this chapter.

In this chapter, the three ways in which teacher attributions shaped professional growth which emerged were: how teacher attributions shaped professional growth through improvisation; how teacher attributions shaped professional growth through handling learner diversity; and how attributions shaped teacher professional growth through networking.

With regard to how teacher attributions shaped professional growth through improvisation, two sub-themes emerged: improvisation in laboratory work and innovation. Findings indicated that Physical Sciences teachers indicated that their attributions shaped their professional growth through improvisation by way of demonstrations in laboratory work where there was an absence of proper laboratory apparatus. Teacher attributions also shaped their professional growth through the use of simulations where there was a shortage of apparatus. In handling large classes, the teacher attributions shaped their professional growth as they were innovative in splitting learners into smaller manageable groups during practical demonstrations. Improvisation and innovation were both internal attributions which shaped their professional growth, while lack of laboratory equipment was an external attribution which the teachers could not control. These findings were prevalent across all three contexts (Rural, Township and Urban).

With reference to how attributions shaped teacher professional growth through handling learner diversity, two sub-themes emerged: growth through CS and growth through handling progressed learners. It emerged that Physical Sciences teacher attributions which shaped professional growth were through CS, where leaners had challenges in understanding some Physical Sciences concepts expressed in English. With regard to progressed learners, professional growth was shaped through grouping learners according to their ability, teaching and assigning those activities that matched their cognitive capability, hence, professional

growth occurred in the methods of teaching (PK). While learner diversity and limited learner ability were external attributions which were beyond teachers' control, how the teachers handled the issues were all internal attributions cutting across all three contexts.

With regard to how attributions shaped teacher professional growth through networking (internal attribution), which was also prevalent across all three contexts, it emerged that Physical Sciences teacher attributions shaped their professional growth through in-school, cluster and district level networking. From the discussion above, Physical Sciences teacher attributions shaped their professional growth related to their methods of teaching.

Having discussed how attributions shaped Physical Sciences teachers' professional growth, in the next chapter I discuss and synthesise the findings of this study, draw conclusions and lessons, and offer recommendations.

CHAPTER SEVEN
DISCUSSION, SYNTHESIS AND CONCLUSIONS

Introduction

The purpose of the study was to explore Grade 12 Physical Sciences teacher attributions to their pedagogical practices in UMzinyathi secondary schools and how these attributions shape their professional growth. As alluded to in previous chapters, attributions are the explanations or reasons that teachers give for their actions, behaviour, feelings or beliefs, skills and knowledge, from where they draw teaching and learning experiences (Weiner 2005). In other words, these are the basis for the teachers' classroom and pedagogical choices, decisions and actions. Attributions are critical to teacher professional practice and professional growth as they shape their decisions and choices on instructional behaviours, processes and learner tasks (Nespor 1987; Pajares 2003; Riley and Ungerleider 2016). Thus, teacher attributions to teaching and learning have a great impact on their pedagogical practice and development. Borg (2003) points out that not only are teacher classroom actions strongly shaped by their attributions, but also their professional learning and growth. This is confirmed by Guskey (2009; 2014), who points out that it is only when teachers regard themselves as lacking in knowledge that they become open to new learning. When they see themselves as 'knowing it all' they will not accept any new learning, and in the absence of learning there is no growth.

Physical Sciences is a natural science subject and in South Africa the subject combines both Chemistry and Physics and is taught from Grades 10 to 12. Among natural science subjects (Physics, Chemistry, Life Sciences, and Agricultural Sciences) examined at the National Senior Certificate level in 2016, Physical Sciences was ranked lowest (DBE 2017) in candidates' performance, hence, the need to focus on the subject. The Department of Basic Education's revised Action Plan 2017 to 2025, is to "increase the number of learners who pass Physical Sciences" (DBE 2021).

South Africa as a developing country has potential for great achievement in the science and technology areas and, as indicated earlier in Chapter One, scientific related projects like the South African Large Telescope (SALT) located in Sutherland bear evidence (Kelder 2008:35). This achievement contributes to the country's economic growth. Physical Sciences as a subject is vital given its focus on investigating physical and chemical aspects of science through scientific enquiry as demonstrated in the SALT project. The Department of Education (2003)

in emphasising the value of sciences stresses that these subjects prepare learners for active national economic activity, critical thinking, problem solving, self-expression, acting responsibly towards the environment and developing alternatives in difficult situations. In society, science education is valued, given that it sets the precedence for academic success as a stepping stone for entrance into more prestigious occupations (Okoye 2009). Students often develop such qualities if teachers possess appropriate attributions.

The performance in Physical Sciences at the time of the study was, and probably still is, deteriorating each year, especially in UMzinyathi district. What Physical Sciences teachers in secondary schools attributed their pedagogical practices to and how these attributions affected their professional growth, needed to be known. Therefore, the objective of this study was to understand Physical Sciences teacher attributions to their pedagogical practices in secondary schools and how that influenced their professional growth. It is from this understanding that 16 Physical Sciences teachers were selected from rural, township and urban secondary schools of UMzinyathi district in KwaZulu-Natal to provide data for answering the key question: *What is the nature of Physical Sciences teacher attributions to their pedagogical practices in UMzinyathi district and how do these attributions influence their professional growth?*

To answer this main question, two sub-questions were developed:

1. What is the nature of Physical Sciences teacher attributions to their pedagogical practices in secondary schools?

2. In what ways do the Physical Sciences teacher attributions shape their professional growth?

Answering these questions would enable the thesis to explain the Physical Sciences teacher attributions to their pedagogical practices in secondary schools and how they shape their professional growth. Such knowledge was deemed vital as it would inform policy discussions and decisions on enhancing learner performance in Physical Sciences.

The preceding two chapters, (Chapter 5 and Chapter 6) focused on answering the sub research questions one and two respectively. This chapter (Chapter 7) analyses, discusses and synthesises findings explaining the nature of Physical Sciences teacher attributions to their pedagogies. Informed by the findings, the chapter explains Physical Sciences teacher attributions and how they influence their growth as professionals in that light and extracts some lessons for enhancing learner performance in the province in general, and in the teachers and schools studied in particular.

The chapter is divided into seven subsections. Immediately after this introduction, I reflect on the theoretical approaches that I adopted, followed by reflections on the methodological approach to this study. This is followed by a review of the study where I synthesise the main issues in each chapter. Subsequent to this is the discussion of key findings under the different research questions. Section four focuses on the original contribution of the study. A discussion on the implications and recommendations drawn from the study will follow. The chapter closes with a summary.

Theoretical Reflections on the Study

My study which explored Physical Sciences teacher attributions to their pedagogical practices in secondary schools and how these attributions shape their professional growth drew on Weiner (1986) who advanced a theory of causal attribution, complemented by Bell and Gilbert's (1996) Aspects of Professional Learning. An attribution, as alluded to earlier, is a person's perceived reason that they give for a particular event or action (Weiner 1986). It, therefore, refers to the explanations or reasons that people give for their own or other people's actions or behaviour. This study discovered that combining Weiner's (1986) theory of causal attribution with Bell and Gilbert's (1996) Aspects of Professional Learning was effective in understanding the nature of Physical Sciences teacher attributions in secondary schools and their influence on the teachers' professional growth. This combination was effective in understanding, describing and explaining answers to the main research question.

Attribution theory has its roots in Heider (1958) who investigated how people interpret events in their everyday lives. Many researchers (see, for example, Kelly 1976) have since proposed their own attribution understandings using the concept in achievement-related educational settings. But Weiner (1986) proposes four causes, which are the most general and significant, used to interpret the outcome of an achievement-related event: ability; effort; task difficulty; and luck. Ability and effort attributions are internal attributions, whereas task difficulty and luck are external attributions. Thus, dispositional (internal) attributions include all causes that are internal to the teacher like attitudes to their work or subject, personality traits which affect their teaching (including classroom management), teaching abilities (Subject Content Knowledge, Pedagogical Content Knowledge and Pedagogical Knowledge) or wishes. On the other hand, situational (external) attributions include all causes that are external to the teacher like learner attitude towards the subject, learner ability (progressed learners included), resourcing, collegial interactions, social situations, or any other such work-related aspects

(Weiner 1986) which the teacher cannot control. Weiner (1986), in addition, asserts that individuals' causal explanations (attributions) of success or failure affect their pedagogical practices.

In this study, therefore, Physical Sciences teachers were expected to highlight their attributions (possible explanations, basis or reasons) to their teaching practices, choices of teaching approach and resources, decisions and performance in this subject. Drawing from Weiner (1986), findings from this study seemingly suggest that Physical Sciences teacher attributions combined (internal and external) have a great influence on their professional growth, paving the way for change. The use of Weiner's (1986) theory of causal attribution was effective in revealing the nature of Physical Sciences teacher attributions, i.e., whether they were internal or external.

The complementary theory, Bell and Gilbert's (1996) Aspects of Professional Learning, also as highlighted above, was intended to help unpack, understand and explain the impetus for professional learning and growth. According to these authors teacher professional learning is comprised of personal, social and occupational aspects which are inter-related. The personal dimension includes beliefs, attitudes and values which contribute to and shape the teacher's professional growth. For the social dimension, relationships between individuals and groups influence professional learning and growth. As for occupational, Bell and Gilbert (1996) advocate for a strong link between theory and practice and the need to marry them. These two aspects enhance professional growth. The combination of Bell and Gilbert's (1996) theory and Weiner's (1986) attribution theory was effective in answering my research questions by enabling analysing the nature of attribution and the dimension or impetus for professional growth.

Methodological Reflections on the Study

My study was located in the interpretive paradigm which adopted a multiple-site case study and a qualitative approach where face-to-face interviews (which were audio recorded), document reviews and lesson observations were used to generate data. Given that this study focused on attributions which deal with behaviours, beliefs, opinions and emotions, a qualitative approach within a case study design was appropriate for the study as I was able to understand these aspects from the teachers' perspectives. Convenience and purposive sampling designs were employed to sample out 16 Grade 12 Physical Sciences teachers from where data were generated. All the teachers were drawn from UMzinyathi district of KwaZulu-Natal

(KZN). These non-probability sampling designs were aligned to the philosophical orientations (interpretive paradigm, case study design and qualitative approach) which sought data from the perspectives of the participants.

Convenience sampling (Patton 2002) was effective as I was able to identify accessible schools from deep rural, township and urban areas. UMzinyathi district is predominantly rural (Hugo, Jack, Wedekind and Wilson 2010), and most schools were situated and reachable through gravel roads, therefore, through convenience sampling I was able to select appropriate sites. All 16 secondary schools were easily accessible in terms of distance and geographical locations.

With reference to purposive sampling, this was also an appropriate technique which helped me extract Grade 12 Physical Sciences teachers who participated in the study. This sampling design was appropriate as I was able to extract participants who were deemed information-rich (Mukeredzi 2009). Extracting teachers from three contexts (rural, urban and township) enabled comparisons both within contexts and across contexts which enhanced the robustness of findings.

The proximity of the schools enabled me to generate data from an average of three schools in one day thereby saving me time and transport costs. In addition, conducting three interviews in one day also helped in terms of the quality of data generated. I discovered that my questioning and probing technique was improving as I moved from one question to the other and from one participant to the other.

Data generation employed two series interviews (Seidman 1998) as outlined in the methodology chapter. I found the face-to-face individual interviews effective in enabling generation of in-depth data. In addition, that all participants agreed to be audio recorded helped with accurate capturing of responses and enabled me to focus on the participants and the interview rather than on note-making. This enhanced the rigour of the study. I learnt that audio recording allowed participants more time to explain in-depth without interjections which gave me space to probe further. The two series interviews enabled reflection on the process before going to the second interview and enabled me to fill up any gaps in the data during Interview Two. In addition, as interviews were done within 1– 2 weeks of each other, this enabled confirmation of internal consistency of participants' stories (Mukeredzi 2009). I, therefore, had to ask some questions related to Interview 1. I also discovered that the time taken in Interview

2 (on how these attributions influence their professional growth) was more than that taken in Interview 1 (the nature of Physical Sciences teacher attributions to their pedagogy). The participants had seemingly developed confidence and trust in me to talk more. The WhatsApp communications, repeated phone calls to make appointments, remind and confirm appointments, as well as the refreshments offered probably enhanced this trust and participation without any one participant missing any appointments.

I completed document reviews first and then lesson observations on different days to allow for critical reflections on the document reviews before moving on to lesson observations. Reflection was critical for learning during this process to ensure addressing any necessary modifications (Mukeredzi 2015). I learnt that reviewing documents during this period enabled me to establish a pattern of their attributions and how they would play out in their pedagogical practice in the classroom. This also allowed me to probe further based on what I had observed from the documents, thus helping me in establishing consistency in their attributions. The participants were free to display their Annual Teaching Plans (ATPs), lesson plans and learners' work books. Research shows that professional growth can be understood against some legitimate framework (Mukeredzi 2009): adopting document reviews as a data generating technique provided that framework.

One of the notable challenges that I encountered during my data generation was that two of my participants transferred from their original schools through promotion immediately after Interview 1. The schools they relocated to were very far from my work place and defeated the aspect of convenience due to distance and accessibility, consequently, affecting my original transport budget. However, I had to be flexible and prepared for any possible eventualities when dealing with participants: as a result I had to adjust my budget. Their relocation did not affect the amount and quality of data generated because both were still teaching Physical Sciences in Grade 12 in the same district and still in rural contexts. I, therefore, had to go to their distant schools and finish off data generation processes.

Review of the Study

This study consists of seven chapters. The following section reviews the chapters.

Chapter One

The chapter discussed background information, thereby setting the scene for the study. It was in this background where teacher attributions were introduced. In addition, the value of teacher

attributions in relation to the teaching of Physical Sciences, as well as its value to the economy of the country was discussed. A synopsis of the history of teacher education in South Africa from the Pre-Liberation Era to the Post-Liberation Era and the policy context was provided. The discussion included the context of teaching and learning of Physical Sciences in South Africa. The focus and purpose of the study was also outlined. This was followed by a synopsis of my personal context, and motivation for the study and the axiological assumptions, as well as the rationale, behind this study. The statement of the problem and research questions were highlighted. Subsequent to this, was an overview of the theoretical frameworks guiding this study, as well as the methodological approaches adopted. The chapter also defined the key terms used in this study. The structure of the study was outlined and this was followed by a chapter summary.

Chapter Two

This chapter presented a critical review of related literature which was organised conceptually drawing on the research questions. The chapter commenced by defining and discussing the concepts around professional growth and its derivatives: profession; professional; and professionalism. It finished off with professional growth from international, regional and national understandings.

The review of literature started with international studies, followed by regional studies and, finally, local literature on teacher attributions and professional growth. International literature consulted shows that teachers attributed their pedagogy to both internal and external factors (Johansen, Little and Akin-Little 2011; Kulinna 2009; Petrie 2013; Riley and Ungerleider 2012; Adams 2012; Vail 2011). Regionally, consulted literature shows that apart from attributing their pedagogical practices to external factors (such as lack of resources) many teachers did not teach Physical Sciences because of poor understanding of the teaching materials and a lack of confidence to teach the subject (Lyakurwa 2012; Kafyulilo 2010). This was true for some participants in this study. Further from the regional context, literature critically surveyed suggests that teachers are more likely to stay motivated to try a task again in the future if they have attributed the cause of the original outcome to factors that are unstable controllable. Local literature consulted indicates that many learners tend to avoid Physical Sciences because of fear of the subject and a lack of self-confidence (Steyn 2010; Ramnarain and Hlatswayo 2018). Research further points out that although teachers sometimes master the theory of Physical Sciences, putting the theory into practice is a major problem (Gudyanga and

Jita 2019). Across the three contexts, literature indicates that teachers attribute their pedagogical practices to both internal and external factors.

Generally, across all contexts, little research had been done around teacher attributions, beliefs and practices specific to Grade 12 Physical Sciences teachers and how attributions influenced professional growth. Therefore, this study sought to contribute to literature around teacher attributions and professional growth.

Chapter Three

Chapter Three presented the two theoretical frameworks which guided this study. Weiner's (1986;2005) theory of causal attribution provided guidance on the nature of Physical Sciences teacher attributions to their pedagogical practices while Bell and Gilbert's (1996) Aspects of Professional Learning enabled unpacking and explaining issues around teacher professional growth.

Historical development, principles and application, and critique of these theories were discussed. Weiner (2005) proposed four causes, which are the most general and critical, used to interpret the outcome of an achievement-related event: ability; effort; task difficulty; and luck. Ability and effort attributions are internal attributions, whereas task difficulty and luck are external attributions. As highlighted above, these four principles enabled understanding and explaining the nature of Physical Sciences teacher attributions to their pedagogical practices in secondary schools. The Chapter further discussed Bell and Gilbert's (1996) Aspects of Professional Learning. According to these authors, teacher professional learning is comprised of personal, social and occupational aspects which are inter-related. These three dimensions were key to the discussions on how teacher attributions shaped their professional growth.

Chapter Four

Chapter Four, Research Design and Methodology, discussed the methodology that was adopted in this study. The interpretive paradigm, the multiple-site case study design, qualitative approach and the sampling techniques employed to extract respondents were all discussed and moves and choices justified. This chapter also presented and discussed the three research sites, namely, rural, township and urban. Each research site was defined and discussed separately under school size and enrolment and resourcing. Justification for drawing on each research site was also discussed. This chapter further discussed how participants were accessed including the pilot study and its justification. This chapter further discussed and justified the three

techniques used to generate data: individual Face-to-face Interviews, Document Reviews and Lesson Observations. In addition, as this was a qualitative research, this chapter discussed the issue of rigour and trustworthiness, focusing on the four criteria of credibility, transferability, dependability and conformability (Guba and Lincoln 1994). Ethical issues that were considered throughout the study were discussed, as well as limitations of the study, which preceded the chapter summary.

Chapter Five

This chapter presented and analysed data addressing Research Question One: the nature of Physical Sciences teacher attributions to their pedagogical practices. Weiner's (2005) theory of causal attribution provided guidance in analysing, describing and explaining findings. Participants' biographical data was presented and discussed. Four themes emerged from the data: teacher attributions related to classroom practice; teacher attributions related to resources; teacher attributions related to learner factors; and attributions related to teacher competence. These were discussed through their sub-themes. In presenting findings, I drew on literature surveyed to show how my findings related to existing research.

Chapter Six

The chapter presented and discussed data answering Research Question Two on how teacher attributions shape their professional growth. This discussion drew mainly on Bell and Gilbert's (1996) Aspects of Professional Learning to unpack and explain the findings. Three themes emerged: professional growth through improvisation; professional growth through handling learner diversity; and professional growth through networking. As was the case in Chapter Five, these themes were discussed independently through their sub-themes and literature was brought in to show the relationship with my findings.

Chapter Seven

This Chapter is the final part of this thesis which presents the discussion, synthesis and conclusions. The chapter discussed and attempted to provide a synthesis on the nature of Physical Sciences teacher attributions to their pedagogical practices and how they shape their professional growth. The chapter outlined the theoretical reflections on the study, followed by methodological reflections. Subsequent to this was a review of the study. This chapter also discussed the contribution of this study, recommendations drawn out of the findings related to policy and practice, as well as recommendations for further research.

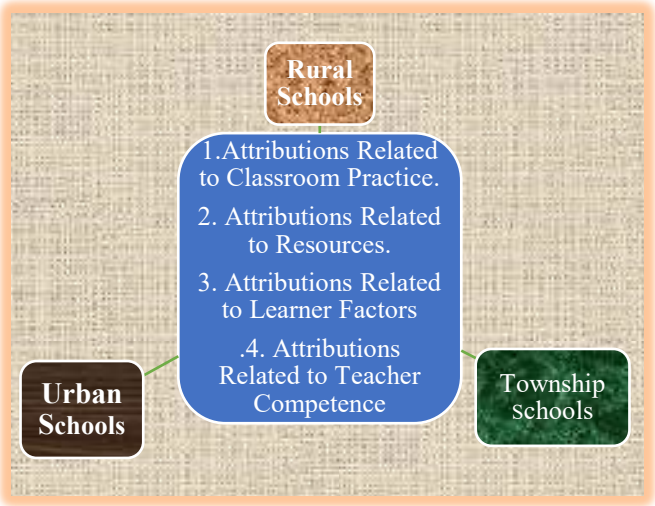
Discussion

The purpose of the study was to explore Grade 12 Physical Sciences teacher attributions to their pedagogical practices in UMzinyathi secondary schools and how these attributions shape the teachers' professional growth. Data generated in this study addressed the key question through its two research questions. The following section discusses answers to Research Question One:

> *What is the nature of Physical Sciences teacher attributions to their pedagogical practices in secondary schools?*

In answer to this question, the Physical Sciences teacher attributions to their pedagogical practices in UMzinyathi district secondary schools were both internal and external in all the three contexts in this study (rural, township and urban). These internal and external attributions which emerged in this study are reflected Figure 7.1

Figure 7.1 Physical Sciences Teacher Attributions to their Pedagogical Practices from Three Contexts



Source: Researcher (2022)

Figure 7.1 above reflects the nature of Physical Sciences teacher attributions that emerged from all three contexts. Riley and Ungerleider (2012) from literature surveyed, assert that teacher attributions are prevalent in all contexts and cultures and this is in line with findings from this study. The attributions that emerged as discussed in Chapter 5 were both internal and external. The following section discusses the Physical Sciences teacher attributions related to classroom practice.

Attributions Related to Classroom Practice

Findings from this study show that all 16 Physical Sciences teachers attributed classroom practice to lesson preparation and planning, lesson delivery and classroom management, as illustrated in Figure 7.2 below.

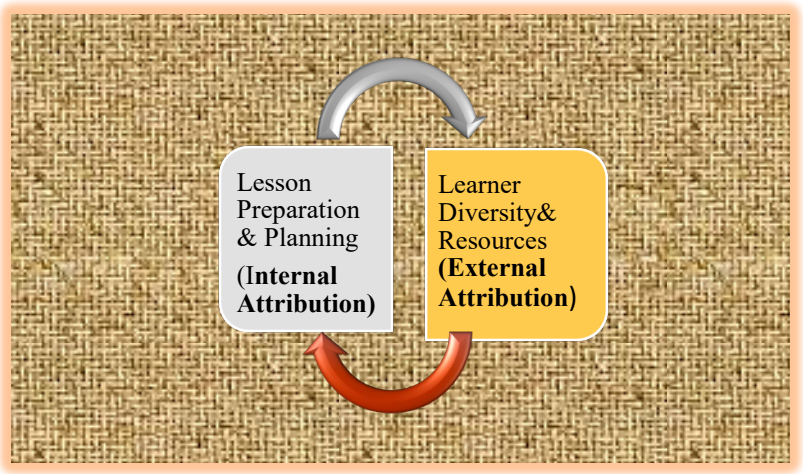
Figure 7.2: Teacher attributions related to classroom practice.

Source: Researcher (2022)

Lesson Preparation and Planning

In all three contexts, Physical Sciences teachers attributed their lesson preparation and planning to the ability of learners, availability of resources and reports from National Senior Certificate (NSC) examiners. This study discovered that all Physical Sciences teachers acknowledged lesson preparation and planning as a key aspect in classroom practice. This is in line with surveyed literature (Mukeredzi 2013) which shows that lesson planning is essential as it increases teacher efficiency and confidence. From the attribution perspective, lesson preparation comes from *effort* which according to Weiner (2005) is an internal attribution. In this study, this internal attribution was influenced by other external attributions such as learner diversity, resources and examination reports. Lesson preparation is controllable like all other internal attributions but is determined by external and uncontrollable variables such as learner ability and resource availability. This, consequently, suggests a strong link between internal and external attributions with regard to classroom practice as illustrated in Figure 7.3 below.

Figure 7.3: Link between Internal and External Attributions in Lesson Preparation



Source: Researcher (2022)

As illustrated in Figure 7.3, lesson preparation is determined by the ability of learners, as well as the resources around the teacher. In this study the teachers were able to control their lesson plans to accommodate learner diversity and use the available resources around them despite the contextual factors. It emerged that in lesson preparation, the internal attribution, teachers considered reports from the NSC external examiners. Physical Sciences teacher attributions related to lesson preparation and planning form the foundation for professional growth (Ramnarain and Hlatswayo 2018). These findings were consistent with Weiner's (2005) attribution theory which shows that pedagogical practices are controlled by teacher beliefs and values (attributions) regardless of whether they are controllable or uncontrollable. The nature of Physical Sciences teacher attributions to their pedagogy was also reflected in lesson delivery which I discuss in the next section.

Lesson Delivery

With reference to lesson delivery, the Physical Sciences teachers in this study across all contexts attributed this to appropriate teaching strategies, active teacher-learner and learner-learner interaction, as well as learner engagement in activities. Mukeredzi (2013) in literature surveyed asserts that teacher attributions and conceptions determine their pedagogical approaches, as well as choices of materials, content and learner activities. Thus, Physical Sciences teachers attributed lesson delivery to their chosen teaching strategies, given that effectiveness of delivery is often dependent on the teaching approaches a teacher employs. Teaching strategies as an aspect of lesson delivery is discussed in the next section.

Teaching Strategies

While lesson delivery was attributed to teaching strategies, findings revealed that all 16 Physical Sciences teachers attributed the teaching strategies to learner knowledge, their everyday experience and the use of examples from learners' contexts. Physical Sciences teachers also attributed their pedagogical strategies to learner ability where they had to choose either group work or individual work. Drawing from Weiner's (2005) theory all these attributions were external to the teacher. Contextual factors around the learner are uncontrollable for the teacher, however, the teacher is prompted to use examples to enhance learner understanding. Some teachers used ability grouping while others used mixed ability grouping, which are both internal attributions.

Literature consulted (Murphy et al. 2017; Fischer 2018) criticised mixed ability grouping, asserting that scattering intelligent learners around the class may promote arrogance in the learners by making them feel superior. However, other sourced literature (Mozingo 2017) indicates that mixed ability grouping is effective since it creates uniformity in class, making struggling learners feel accepted which makes some develop confidence thereby promoting learning. On the other hand, Weiner's (2005) attribution theory supports ability grouping showing that if learners are to develop intellectually, then they need to measure themselves with appropriate yardsticks and in this case, comparisons with peers are more likely to be accurate when made with others of similar abilities. Thus, an appropriate yardstick was found in ability grouping where struggling learners were mixed with able learners. Teacher ability to group learners according to their performance is an internal attribution (Weiner 2005) and such pedagogical skills can change over time. Seemingly, the flexible nature of internal attributions allowed teachers room for teacher growth. Consulted literature shows that using a variety of teaching strategies reduces boredom, stimulates learner interest and encourages learners to become more active participants in the learning process (Ivy 2013). Physical Sciences teachers also attributed their lesson delivery to learner activities and this is discussed in the next section.

Learner Activities

Findings from this study indicated that all 16 Physical Sciences teachers attributed their selection of classroom activities to lesson objectives and learner diversity. Moreover, of these 16 Physical Sciences, 12 teachers also attributed their selection of activities to previous examination questions. Learners were engaged in practical demonstrations during experiments

in schools which had appropriate resources and in observing simulations. In the document reviews, written work was noted in all sites, which formed part of learner activities.

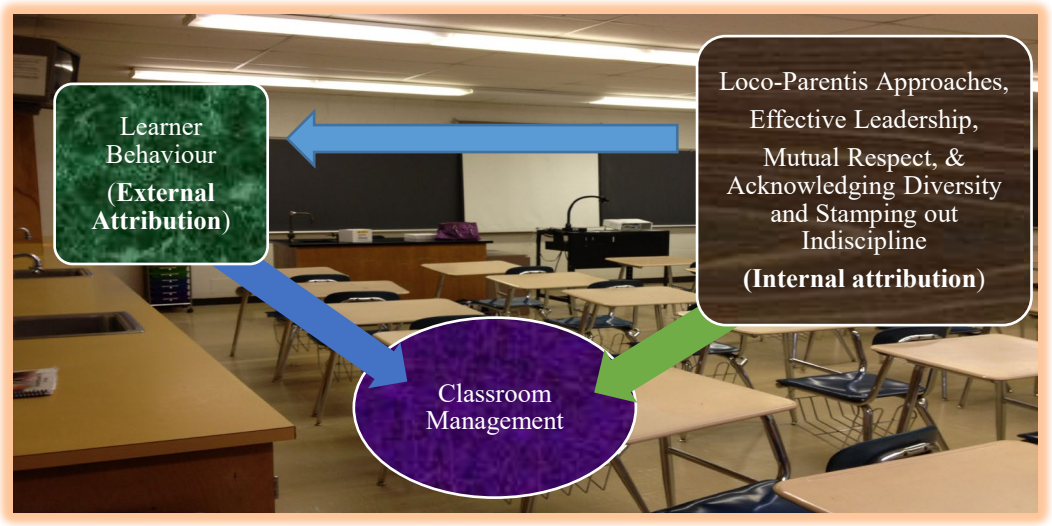
In this study lesson objectives were internal attributions which the teacher could control to accommodate other external attributions (learner diversity and previous examination questions) in pedagogical practices. As pointed out in previous discussions, seemingly there is a strong link between internal and external attributions and the two factors work hand in hand in teacher pedagogical practices. Engaging learners in a variety of activities is consistent with theory where Weiner (2005) recommends that teachers should provide learners with sufficient opportunities to practice. Literature surveyed (Murphy et al. 2017) further emphasises that learner activities are key to learner understanding since they allow them to explore and understand concepts through practice. Consequently, learners' exploration during classroom activities reduces boredom, stimulates learner interest and curiosity and develops their confidence and problem-solving abilities.

Engaging learners in classroom activities drawn from previous examination papers, as the 12 participants did, was also in line with literature (Murphy et al. 2017), which indicates that if learners practice for the examination, they stand a better chance of doing well in that task, and such practices are essential components of learner motivation. However, critics of the expository approaches from surveyed literature argue that a focus on the examination does not provide learners with opportunities to develop holistically to achieve high cognitive skills since the focus is narrow (Josephsen and Hvidt 2015). Nonetheless, despite the mentioned weakness, it seems drawing activities from previous question papers enabled teachers to administer standard and quality questions thereby giving learners adequate examination preparation and cognitive development skills and such an approach leads to teacher professional growth. The next section discusses classroom management.

Classroom Management

All the 16 Physical Sciences teachers attributed their classroom management to learner behaviour (external attribution), loco-parentis approaches, effective leadership and good management skills, which included mutual respect, acknowledging diversity and stamping out indiscipline (internal attributions) before it got out of hand. The teachers explained that these were key to a successful lesson. The findings, therefore, indicate that classroom management is mostly driven by internal factors which are controllable by the teacher since they are flexible, and such attributions are unstable and fluctuate over time, according to theory (Weiner 2005).

Figure 7.4: Attributions in Classroom Management



Source: Researcher (2022)

Interestingly, drawing from Figure 7.4 above, while learner behaviour is an external attribution (stable and uncontrollable according to theory), from this study it emerged that the Physical Sciences teachers used their internal attributions (unstable but controllable) to control learner behaviour. This further emphasises the notion that there is a strong link between internal and external attributions as illustrated in Figure 7.4 above. As previously mentioned, from the theoretical perspective, the ability to manage learners in a class is an internal attribution (Weiner 2005) which the teacher has total control over and this can change depending on the environment. Physical Sciences teachers in this study used their classroom management skills to shape their professional growth.

These attributions related to classroom management are consistent with surveyed literature (Cruickshank and Haefele 2014) which indicates that effective teachers treat their students with respect and expect the same in return, enhancing the students' learning progress. In addition, drawing from Figure 7.4, using internal attributions (Weiner 2005) such as loco-parentis approaches and mutual respect in classroom management is in line with South Africa's DBE policy on the seven roles of an educator, which stipulates that an educator must demonstrate a pastoral role (DBE Government Gazette: The MRTEQ 2015) among other roles. The above discussion suggests that teachers probably shaped their professional growth with attributions related to classroom management since such attributions enhanced teaching and learning. The next section discusses attributions related to resources available.

Attributions Related to Resources

Physical Sciences teachers attributed their pedagogical practices to teaching and learning material and physical infrastructural resources. For clarity, the discussion will treat each section separately.

Teaching and Learning Material Resources

11 Physical Sciences teachers reported that they attributed their pedagogical practices to a shortage of teaching and learning materials. Laboratory equipment such as apparatus, chemicals and calculators, were the most commonly cited resource shortages in the teaching of Physical Sciences. Participants further reported that the shortage of such resources impacted negatively on their pedagogical practices and, consequently, shaped their professional growth.

Of these 11 participants, 8 were from Rural schools (and this constitutes 100% of the rural sample) and 3 were from Township schools (75% of the Township sample). No participants from urban schools attributed their pedagogical practices to under-resourcing and this made the rural context appear marginalised. These statistical differences are in line with literature (Arnold 2005; Moletsane 2012) which shows that rural contexts the world over face challenges and there is little support offered. Moreover, literature further confirmed that teaching is characterised by great unevenness in terms of availability of resources (Hansen 2009; Moletsane 2012).

Teacher attributions related to resources suggested that the teaching of Physical Sciences required resource materials to carry out laboratory experiments, given that the subject demands practical activities. However, findings from this study indicated that these resources were unavailable in most schools, particularly in the rural contexts explored. These findings are consistent with consulted literature (Ramnarain and Hlatswayo 2018) which shows that the enactment of Curriculum and Assessment Policy Statement (CAPS) in Physical Sciences, especially its emphasis on inquiry-based learning, has been frustrated by the shortage of resources in schools which limits teacher pedagogical practices and, consequently, contributes to poor learner performance. Such external teacher attributions have a bearing on teacher professional growth because lesson preparation and planning and, consequently, lesson delivery, are attributed to resource availability.

Still on teacher attributions related to resources, findings in all contexts indicated that there were adequate textbooks, contrary to the usual cries that DBE neglects rural schools in terms

of reading resource provision as the textbook sharing ratio was 1:1. Moreover, literature sourced (Biddle and Azano 2016) related to the learner-textbook sharing ratio suggests that there was renewed interest in rural education which afforded new opportunities for research, policy and practice. The availability of textbooks (an external attribution) shaped teacher professional growth as there were fewer barriers to focus on in their pedagogical practices. Closely related to teaching and learning resources are the physical infrastructural resources which I discuss next.

Physical Infrastructural Resources

Findings from this study indicated that all Physical Sciences teachers in rural (eight) and some (three) in township schools attributed their pedagogies to lack of infrastructure and, specifically, absence of laboratories. As alluded to in the preceding section, such attributions are external to the teacher and are uncontrollable, notwithstanding that they influence their pedagogical practices. Contrarily, none of the urban participants attributed their pedagogical practices to lack of infrastructural resources. These differences are supported by literature sourced (Paine 2013) which indicates that schools in urban areas have higher quality infrastructure and are better resourced compared to schools in rural villages. This was the case in this study where rural schools were severely under-resourced. Lack of these facilities in the rural schools studied is likely to have greatly compromised teaching and learning as teachers attributed their classroom practice to these external attributions (the shortage of laboratories).

Findings from this study further revealed that lack of laboratory facilities and other Physical Sciences related material, limited teaching of the subject to a theoretical level, as laboratory related experiments – the practical aspects – were not possible. These external attributions are in line with theory (Weiner 2005) which shows that such factors are stable and uncontrollable but they have an influence on teacher pedagogical practices and, consequently, their professional growth.

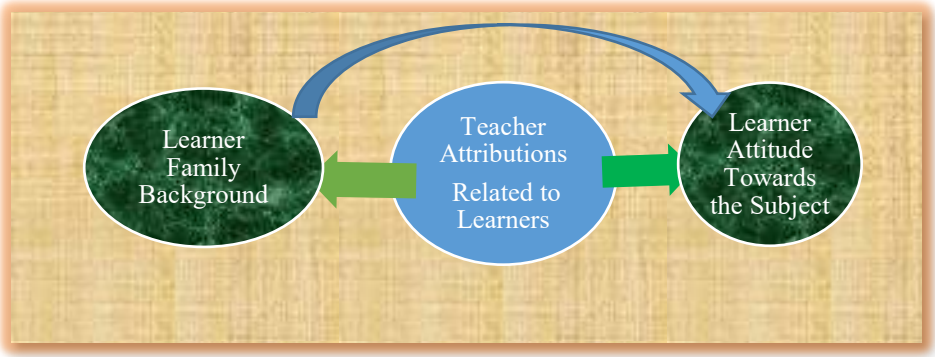
Further, regarding the lack of infrastructure, some teachers also attributed their pedagogies to class sizes (external attribution) as these determined their decisions on choice of materials, methods and learner activities. Contrarily, their counterparts in urban sites attributed their pedagogical practices to the availability of such facilities. From the attribution theory (Weiner 2005) infrastructural resource shortages are external attributions. Seemingly, these external attributions had a negative impact on teacher pedagogical practices, as supported by surveyed literature (Department of Education 2009), which indicates that Physical Sciences teachers who

teach smaller classes show more positive attitudes to learners and their pedagogical practices and, consequently, improve learner academic achievement compared to those who teach large classes. Having discussed resource-related attributions, the next section focuses on learner related attributions.

Attributions Related to Learners

Findings from this study show that Physical Sciences teachers attributed their pedagogical practices to learner family background, and learner attitude towards the subject as illustrated in Figure 7.5 below. Drawing from theory (Weiner 2005) these are external and uncontrollable attributions. These sections are discussed separately for clarity but where there is a link one factor can be mentioned.

Figure 7.5: Attributions related to learners



Source: Researcher (2022)

Learners' Family Background

Eight Physical Sciences teachers attributed their pedagogical practices to learners' family background with particular emphasis on poor socio-economic status, long distances learners travel and their arrival time at school.

Findings from this study indicated that there is a strong link between learner family background and attitude towards Physical Sciences. Seemingly, learner's family background influences their attitude towards the subject, as illustrated in Figure 7.5 above. These findings are supported by Moletsane (2012) in sourced literature who noted that the learner home background, particularly in rural contexts, is characterized by poverty, unemployment, substance abuse and other social ills, and is often used to explain poor performance in assessment in these schools. In other words, poor performance and a negative attitude towards

Physical Sciences are often attributed to these social ills. Further, a literature search (Baker and Jones 2005) indicates that there is a relationship between low socio-economic status and poor performance in sciences. Poor performance in Physical Sciences leads to the development of a negative attitude towards the subject. While poor performance was not the focus of this study, these issues gave rise to the teacher attributions to their pedagogical practices. The next section discusses learner attitude towards Physical Sciences.

Learners' Attitude Towards the Subject

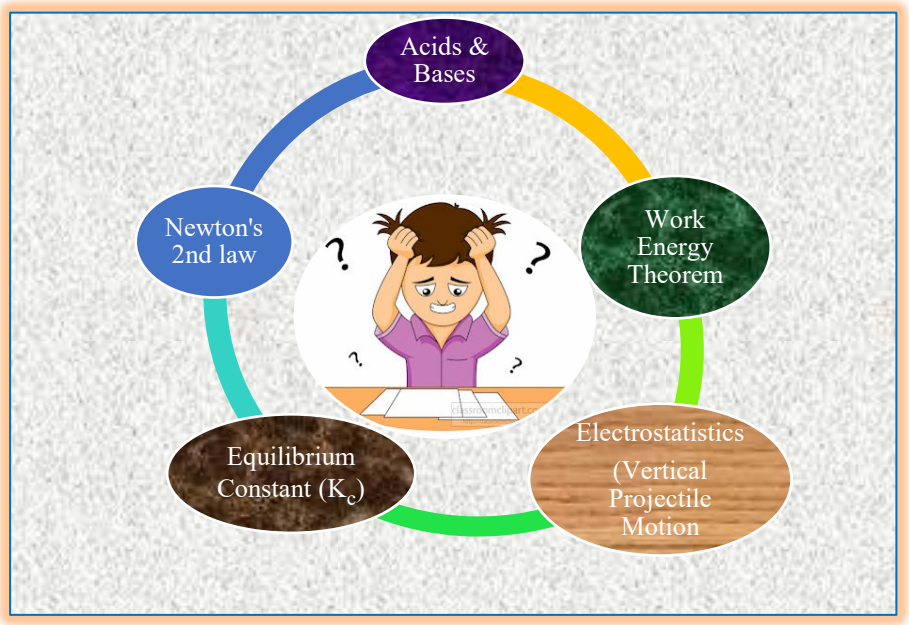
11 participants attributed their pedagogical practices to learners' negative attitude towards Physical Sciences. Drawing from theory (Weiner 2005) attitude towards the subject is an internal attribution to the learner but to the teacher (the subject of this study) this is an external attribution which is stable and uncontrollable.

Findings from all contexts in this study show that the learners' negative attitude towards Physical Sciences was caused by their dislike of numbers (calculations), especially in the Physics section, their lack of effort including the general fear of the subject, labelling it as challenging. These findings are in line with Duit et al. (2015) in consulted literature who point out that Physical Sciences was viewed by learners as a more challenging subject (referred to as *killer subject*) than other learning areas. All these external attributions affected the teachers' pedagogical practices and most likely their professional growth. Attributions related to teacher competence are discussed in the next section.

Teacher Competence

12 participants from all three contexts attributed their pedagogical practices to lack of Subject Content Knowledge (SCK). From theory (Weiner 2005), SCK is an internal attribution which is controllable and can change over time as the teacher has total control over it. Illustrated in Figure 7.6 below are some common topics in which teachers had challenges in SCK and to which they attributed their pedagogical practices.

Figure 7.6: Topics attributed to SCK



Source: Researcher (2022)

Drawing from Figure 7.6 above, Physical Sciences teachers were lacking in SCK in the topics mentioned. Such internal attributions influenced their pedagogical practices and, consequently, teacher growth. Kaya (2013) shows that topics on Acids and Bases and Chemical Equilibrium are major topics in Physical Sciences and are fundamental in the curricula of many countries but learners and teachers struggle with these topics. Further, literature (Bertram et al. 2013) indicates that lack of SCK among South African teachers is rampant, while on the other hand the teacher is regarded as "generic" and capable of teaching anything. However, given the flexibility and controllability of internal attributions (Weiner 2005), it is hoped that these attributions may have changed or may change with time resulting in teacher change. The next section discusses findings which addressed Research Question Two on the influence of attributions to professional growth.

Teacher Attributions and Professional Growth

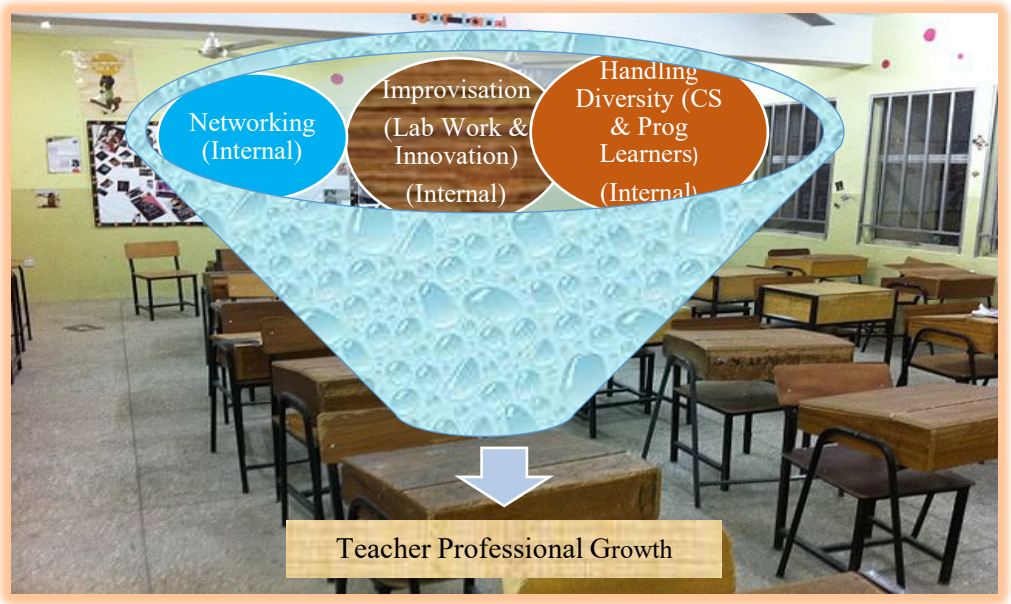
This section discusses Research Question Two:

In what ways do the Physical Sciences teacher attributions shape their professional growth?

Teacher attributions emerged as shaping their professional growth related to improvisation, handling diversity and networking as illustrated in Figure 7.7 below. Drawing from theory (Weiner 2005), these attributions are internal to the teacher and, therefore, they were unstable

and controllable. Findings also show that these attributions were prevalent in all three contexts (Rural, Urban and Township). Drawing from Figure 7.7 below, findings from this study show that a combination of the identified attributions and other possible factors shape teacher professional growth.

Figure 7.7 Attributions that shaped Teacher Professional Growth



Source: Researcher (2022)

Improvisation

The influence of attributions related to improvisation is discussed under two sections: improvisation in laboratory work and improvisation related to innovation.

Improvisation and Professional Growth

Findings from this study show that 14 Physical Sciences teachers attributed their professional growth to improvisation in laboratory work. As was discussed in previous sections some teachers in Rural and Township schools lamented the shortage of laboratory teaching resources. In the absence of these resources the teachers were forced into improvisation. This view of having to improvise due to under-resourcing resonates with ideas of some authorities consulted (see, for example, Appleton 2015; Bertram 2014; Chisholm 2020; Mukeredzi 2009; Mukeredzi 2016) who note that teachers creatively resist the constraints within their classroom and school contexts to reconfigure what it means to be a teacher. Through this process, they satisfy the definition of teachers' work: organising systematic learning. Improvisation and having to 'make do' demands reading and research as an on-going process which fosters professional

growth. In this case, professional growth emanated from under-resourcing, i.e., the lack of laboratory apparatus (external attribution). Findings further indicate that in the absence of laboratory apparatus (external attribution) to conduct practical work, teachers used simulations (internal attribution) and also became creative in using other relevant materials (using car toys to demonstrate principles of motion and velocity) from their contexts to enhance lesson delivery and learner understanding.

Improvisation in laboratory work from this study involved simulations and teacher demonstrations. Literature reviewed (Villegas-Reimers 2003) regarding simulations shows that one of the indicators of teachers' professional growth is the teacher's ability to display knowledge and skills on how to incorporate technology into their classroom practice for the benefit of learners. However, critics of the use of simulations from the surveyed literature (Chen et al. 2014) assert that teachers' lack of simulation experience may hinder the success of learning and teaching and, as well, learners can focus on superficial instead of significant parts of simulations. Nonetheless, from this study improvisation in classroom practice seemingly promoted their professional growth. Bell and Gilbert's (1996) Aspects of Professional Learning show that such skills stem from the occupational domain which emphasises that professional growth is a product of the infusion of theory and practice. Physical Sciences teachers were applying what they probably learnt from Teacher Training institutions in their pedagogical practices using the limited resources at their disposal. What this suggests is that the combination of external attributions and internal attributions shaped Physical Sciences teachers' professional growth. Physical Sciences teacher attributions related to innovation also shaped their professional growth.

Creativity and Professional Growth

13 teachers attributed their professional growth to their creativity (internal attribution). From this study, some teachers lamented large classes (external attribution) which they attributed to their pedagogical practices. To address the problem of large classes teachers showed creativity by dividing the classes into smaller more manageable groups. Consulted literature (Zenda 2020) points out that large classes, particularly in public schools, is one of the outstanding concerns in the education system of South Africa which affects teaching and learning. Seemingly such external attributions had a bearing on teacher professional growth irrespective of their being unstable and uncontrollable. The teachers further showed creativity through utilisation of more able learners to assist their peers. All these skills show teacher creativity

which shaped their professional growth. Teacher ability to deal with complex classroom situations in order to achieve teaching objectives suggests professional growth.

Drawing from Bell and Gilbert's (1996) model of professional learning, creativity is a personal dimension in which the teacher's beliefs, attitudes and values are vital factors in professional growth but it eventually benefits the occupational dimension, in this case, effective classroom practice. The next section discusses handling diversity which also shaped teacher professional growth.

Handling Diversity

With regard to professional growth through handling diversity, two major attributions emerged: Code Switching and handling progressed learners.

Code Switching and Professional Growth

Findings from this study show that all 16 (100%) Physical Sciences teachers acknowledged that the use of Code Switching during lesson delivery shaped their professional growth. Code Switching (CS) from consulted literature (García and Otheguy 2019) is the alternating use of two or more linguistic varieties in a sentence or lesson in the development of a speech or to enhance understanding. The use of Code Switching (CS) was compelled by poor learner English background which gave rise to challenges in understanding some Physical Sciences concepts. All the teachers from the three contexts (Rural, Urban and Township) believed that some concepts were better understood if they were explained in the learners' home language (IsiZulu).

From the attribution theory (Weiner 2005) CS is an internal attribution which the teachers used to control and unlock the external attribution (English as a barrier in learning Physical Sciences). It was through CS that teachers realised that learners understood better and, drawing from this, it seems there was teacher creativity. Consequently, CS shaped their professional growth. Adopting CS during lesson delivery is supported by literature consulted (Barrett and Bainton 2016) which shows that there is great improvement in learner understanding of Mathematics and Science in settings where teachers used English alternating with learners' home language. However, critics of CS from surveyed literature (Johnson and Seltzer 2017) assert that the approach is only effective if the learners are using one mother tongue which the teacher must also be conversant with. In contexts where learners use more than one home language, then the teacher has to be conversant with them all or there will be some challenges

as not all learners will be catered for. However, it appears the teachers in this study were teaching learners whose home language was IsiZulu.

Notwithstanding the limitations cited, the teachers from this study showed professional growth through CS as they all argued that adopting CS brought positive learning outcomes. In addition, from theory (Bell and Gilbert 1996), adopting CS in classroom practice is in the occupational dimension which emphasises a strong connection between theory and practice which contributed to improving their professional growth. The ability to determine where and when to apply CS is what enhanced their professional growth. The next section discusses professional growth through handling progressed learners.

Handling Progressed Learners and Professional Growth

Findings from this study show that 13 Physical Sciences teachers acknowledged that handling progressed learners shaped their professional growth. These teachers explained that progressed learners were a special group of learners who were promoted into the next grade before mastery of skills and knowledge in their current grade. Findings indicated that during lesson delivery the teachers were grouping these learners according to ability. From the theoretical view (Weiner 2005), progressed learners in classroom practice are an external attribution but the ability to identify and handle them was an internal attribution. This further shows that in classroom practice the two types of attributions (internal and external) are closely linked. Seemingly, the ability to draw on one type of attribution (managing the class with progressed learners) to counteract the effect of the other attribution (progressed learners) shows professional growth.

Findings further show that Physical Sciences teachers were giving progressed learners more attention, exposing them to less-challenging questions with few complex ones, and assisting them in answering those questions to develop their confidence and help keep them in school rather than prompting their dropping out of school. These processes shaped their professional growth. Surveyed literature (Petrie 2013) indicates that teachers with internal attribution styles are more motivated to assist struggling learners and such pedagogical styles may shape teacher professional growth.

Moreover, giving progressed learners more attention in class probably boosted progressed learners' confidence and, consequently, their classroom performance. Literature searched (Gurney 2017) indicates that effective teachers who are willing to grow believe that all learners can learn and progress, despite differences in conceptual understanding. Such beliefs and

attitudes (Bell and Gilbert 1996) are related to the personal dimension, stemming from gradual acquisition of knowledge, and professional growth. The next section discusses networking, an attribution that also shaped teacher professional growth.

Networking and Professional Growth

All 16 teachers attributed their professional growth to networking. Teachers from all three contexts believed that networking enhanced their professional growth. Networking (internal attribution) was necessitated by teacher awareness of their professional knowledge gaps in SCK, PK and PCK. While SCK dominated the discussions in the previous sections, a deficiency in one domain of professional knowledge (SCK) affected other realms (PK and PCK).

Findings indicate that networking was prevalent at school level, cluster and district levels. From the attribution theory, this type of attribution is flexible, controllable and unstable since it can change over time (Weiner 2005). Those three indicators (flexibility, controllability and instability) promote teacher professional growth and, consequently, foster teacher change. Interestingly, findings from this study further show that Physical Sciences teachers were able to use an internal attribution (networking) to overcome the negative effect of the other internal attribution (lack of SCK). Moreover, as noted in previous discussions, there is a strong link between internal and external teacher attributions in classroom practice. The ability to identify and accept a personal weakness and provide a solution suggests professional growth.

Professional growth through networking has roots in Bell and Gilbert's (1996) Aspects of Professional Learning which shows that networking is in the social dimension which includes relationships between individuals and groups. The social dimension emphasises that the relationship between individuals and groups has a strong influence on professional learning and growth. Interaction and collaboration with other colleagues at various levels enhanced their professional growth.

In support of networking, literature consulted (Jimoyiannis 2010) suggests that teacher knowledge of Science can be cultivated by engaging teachers in realistic activities which involve learning from peers. In addition, other proponents of networking and collaboration, such as McDonald and Klein (2013) in literature consulted, note that such interaction enhances acquisition of new knowledge in line with the new global environment, promoting creativity and improving the general quality of education. In this study, acquisition of new knowledge and creativity as noted above suggests professional growth. From the discussion above, all

Physical Sciences teachers studied from all the three contexts reported that teacher attributions to their pedagogical practices related to networking shaped their professional growth.

Drawing on the whole discussion on the answers to my two Research Questions raised in Chapter One and repeatedly stated in other chapters, I can conclude that these questions were adequately answered. In the next section I outline the original contribution of the study.

Original Contribution of the Study

The purpose of the study was to explore Grade 12 Physical Sciences teacher attributions to their pedagogical practices in UMzinyathi secondary schools and how these attributions shape their professional growth. The aim was to develop a deeper understanding of the Physical Sciences teacher attributions (beliefs, explanations, basis or reasons) to their teaching practices, choices, decisions and performance in this subject.

From the findings, this study makes three contributions, related to theory and conceptual framework, the nature of attributions in teacher pedagogical practices and the significance of attributions in shaping teacher professional growth.

First, in interpreting and analysing the nature of Physical Sciences teacher attributions to their pedagogical practices, I drew on Weiner's (2005) theory of causal attribution and the complementary theory Bell and Gilbert's (1996) Aspects of Professional Learning which provided guidance on the impetus for professional learning and growth. Weiner's (2005) attribution theory has generally been used to explain successes and failures in academic achievements pointing out that human beings attribute these to four things: ability, effort (internal attributions), task difficulty and luck (external attribution). Moreover, Kelly (1976) widely used the attribution theory in achievement-related educational settings. However, Physical Sciences teachers in this study attributed their pedagogical practices to lesson preparation, lesson delivery, teaching and learning resources, progressed learners and classroom management. These findings that emerged from employing this theory to understand Physical Sciences teacher attributions to their pedagogical practices are the major contribution of this study. I, therefore, assert that Weiner's (2005) theory of causal attributions is effective in understanding Physical Sciences teacher attributions to their pedagogical practices.

Furthermore, Weiner's (2005) attribution theory and Bell and Gilbert's (1996) Aspects of Professional Learning have generally been used separately to understand teacher attributions and professional growth (Guskey 2009) respectively. This study discovered that blending them

is effective in understanding the nature of teacher attributions and how the attributions shape their professional growth. This study further discovered that Weiner's (2005) attribution theory alone could not provide a complete picture of how attributions shape teacher professional growth. Consequently, roping in Bell and Gilbert's (1996) Aspects of Professional Learning proved effective in giving a nuanced picture of attributions and their influence on professional growth which emerged as another contribution of this study.

Second, this study discovered that teacher attributions are effective in classroom practice. It emerged that teacher beliefs and perceptions (attributions) were key aspects in evaluating their SCK, PK and PCK. Seemingly such teacher attributions led to teacher change, consequently, shaping their professional growth. It was evident from this study that Physical Sciences teacher internal attributions were a valuable source of motivation in their pedagogical practices. Internal attributions were unstable and controllable and, hence, teachers were able to manipulate them to their advantage in their pedagogical practices. This finding is supported by Petrie (2013) in consulted literature who noted that teachers with internal attribution styles put more effort into their pedagogies and are likely to stay motivated. On the other hand, this study discovered that external attributions related to teaching and learning are stable and uncontrollable (Weiner 2005) and as such they tend to frustrate teachers in their pedagogy. External attributions such as lack of resources, progressed learners, learners' family background, large classes and learner attitude towards Physical Sciences which emerged in this study were all stable and uncontrollable yet they affected teacher classroom practice. The internal attributions which emerged were lack of SCK and innovation (including CS and use of simulations). Networking and handling learner diversity were unstable and controllable. Teacher beliefs and perceptions (attributions) of why they succeeded or failed influence how they perform tasks in the future (Weiner 2005). Therefore, these attributions were effective in understanding the nature of Physical Sciences teacher attributions to their pedagogy. Therefore, revealing the nature of Physical Sciences teacher internal and external attributions to their pedagogy is another contribution of this study.

Third, findings from this study discovered that teacher attributions play a major role in shaping their professional growth. Concomitant to this, the study discovered that there is a strong link between external and internal teacher attributions in pedagogical practices. The study shows that Physical Sciences teachers used their internal attributions to overcome the challenges brought about by the external attributions. Contrary to the theoretical view that external

attributions are uncontrollable and stable (Weiner 2005), findings from this study discovered that teacher external attributions are controllable. For instance, where there was lack of laboratory equipment (external attribution) teachers improvised (internal attribution) by using simulations. This relationship helped in shaping teacher professional growth. These findings, therefore, contradict views from literature sourced (Athanasiou et al. 2002; Miller and Satchwell 2006) which suggest that teachers with external attributions believe that anything that they do in the classroom will be futile, as it is not going to change and they end up shifting responsibility away from themselves. However, Physical Sciences teachers from this study did not shift the responsibility: instead, they were creative in improvising, loco-parentis and networking. Drawing from this, I argue that this is another contribution of this study. In addition, findings from this study showed that there is a strong link within internal attributions themselves. Lack of SCK (internal attribution) was harmonised by networking (another internal attribution).

Having discussed the original contributions of the study, in the next section I discuss lessons and implications based on the study.

Lessons and Implications Based on the Study

From this study, three implications were drawn: for teacher attributions and professional growth, for policy and for research.

Lessons and Implications for Teacher Attributions and Professional Growth

Findings from this study show that teacher attributions influenced classroom practice. Thus, teacher attributions to teaching and learning have a great impact on pedagogical practice (Borg 2003; Guskey 2009). The same sources further point out that not only are teacher classroom actions strongly shaped by their attributions but also their professional learning and growth. Findings from this study pointed to the fact that in teacher pedagogical practices there is a strong link between external and internal attributions and the combination shapes teacher professional growth. It further emerged that teacher professional growth was mostly shaped by teacher internal attributions (creativity, loco-parentis, good classroom management skills and networking). What this implies is that teacher internal attributions are vital for teacher professional growth**.** Gurney (2017) in consulted literature points out that teachers with internal attributions are willing to help struggling learners and are also prepared to learn.

With regard to networking in particular, it emerged from this study that all 16 Physical Sciences teachers attributed this to their professional growth. Attributing professional growth to networking has been noted in sourced literature (Gupta et al. 2004; Mukeredzi 2009) which suggests that most of teacher learning emanates from collaboration and interaction. Such internal attributions to pedagogical practices enhance the sharing of teaching approaches and materials and these factors may in turn raise the standard of teaching across institutions. This, therefore, has implications for educational administrators as it implies that they must cultivate the spirit of sharing and provide more opportunities for collaboration at school, cluster and district level (Mukeredzi 2016).

Lessons and Implications for Policy

Findings from this study show that there was a critical shortage of laboratory material in most rural secondary schools. In some schools explored in this study, the laboratory itself was not there. The shortage of resources in South African rural schools was also confirmed in consulted literature (Makgato and Mji 2006; Du Plessis and Mestry 2019). What this implies is that there are imbalances in resource distribution in schools, with rural schools being marginalised. Physical Sciences is a practical subject and to ensure that the teaching of this subject does not remain at a theoretical level, stakeholders and the DBE South Africa are called upon to ensure that laboratory materials and resources are supplied in all schools offering Physical Sciences. Findings from this study also revealed that 12 Physical Sciences teachers had content gaps (lacked SCK). Lack of SCK among South African teachers has been noted in many studies (Bertram et al. 2013; Kaya 2013). In regard to teacher content knowledge gaps, this study recommends that DBE considers splitting Physical Sciences into two separate subjects: Physics and Chemistry. This implies that the two subjects will be taught by two teachers who have adequate SCK in each area, given the centrality of these science subjects in national economic development. Findings from this study also show that all 16 Physical Sciences teachers attributed their pedagogy to Code Switching (CS). However, it also emerged that not all terms in Physical Sciences can be explained in the learners' vernacular language: therefore, this study recommends that there be an urgent review by the DBE on policy regarding CS when teaching science subjects.

Implications for Further Research

To further expand and close the gaps in the current literature, this study offers the following suggestions. This study explored 16 Grade 12 Physical Sciences teachers in one district in KZN Province of South Africa using a qualitative approach where data was generated through face-to-face interviews, document reviews and lesson observations and as such the results do not give a comprehensive picture of the Physical Sciences teacher attributions to their pedagogical practices and how these attributions shape their professional growth. The study, therefore, recommends a more comprehensive study with a larger sample of Physical Sciences teachers, using quantitative or mixed methods approaches. This would provide a better picture of the nature of Physical Sciences teacher attributions and how these shape their professional growth.

Chapter Summary

As I wind up my research journey of which the purpose was to understand the nature of Grade 12 Physical Sciences teacher attributions to their pedagogical practices in UMzinyathi secondary schools and how these attributions shape their professional growth, I conclude that teacher pedagogy is attributed to both internal and external attributions.

From the findings and discussions, I further assert that teacher attributions are the basis for the teachers' classroom and pedagogical choices, decisions and actions. Consequently, teacher attributions to teaching and learning have a great impact on pedagogical practice and eventually learner learning. However, with regard to teacher growth, internal attributions emerged as the main actors in shaping their professional growth through creativity, networking and good classroom management skills which dominated the discussions.

The answers that I discussed in this and the preceding chapters illustrated that the main question guiding this study was adequately addressed. The value of teacher attributions in pedagogical practices was summed up by Teacher 4 Rural in a FFI who said:

> *You know, I have been teaching Physical Sciences in this school for the past eleven years, but as you can see there is no laboratory or science kit. The class is very big and some learners did not pass Grade 11 but guess what? I have never scored below 50% in NSC examinations. Complaining is not the solution. I work with what I have, I improvise*

and use the resources around me and produce good lesson. To me creativity and improvisation are key.

The statement above captures it all, showing that teacher attributions are critical to teacher professional practice as they shape their decisions on lesson objectives, material to be used and choices on instructional processes which, consequently, shape their professional growth leading to teacher change.

The lessons from this study and their implications discussed above, if considered will update and contribute to existing literature on teacher attributions to pedagogical practices and professional growth. In addition, if considered implications drawn from this study will have direct applicability for teacher education programmes in South Africa and further afield.

References

Adams, J. H. 2012. Identifying the attributes of effective rural teachers: Teacher attributes and mathematics achievement among rural primary school students in Northwest China. *Gansu Survey of Children and Families Papers*.32.Available:http://repository.upenn.edu/gansu_papers/32 (Accessed: 24 August 2021)

Adendorff, M., Mason, M., Maropeng, M., Faragher, L. and Kunene, Z. 2002. *Being a teacher: professional challenges and choices*. The SAIDE Teacher Education Series. Braamfontein: South African Institute for Distance Education (SAIDE).

Adoukonou, V.K. 2019. Strategies for Small Business Sustainability. *Walden University.* Available: https://scholarworks.waldenu.edu. (Accessed: 10 December 2020).

Akinbobola, A. O. 2015. Effects of learning styles and instructional strategies on students' achievement in Nigerian senior secondary school physics. Available: https://www.iiste.org/Journals/index.php/APTA/article/view/20455 (Accessed: 18 July 2021)

Akiri, A. A. and Ugborugbo, N.M. 2009.Teachers Effectiveness and Students Academic Performance in Public Secondary Schools in Delta State, Nigeria. DOI:10.1080/09737189.2009.11885284 (Accessed: 26 July 2021)

Alase, A. 2017. The interpretative phenomenological analysis (IPA): a guide to a good qualitative research approach. *International Journal of Education and Literacy Studies,* 5(2): 9-19. Available: http://dx.doi.org/10.7575/aiac.ijels.v.5n.2p.9 (Accessed: 20 March 2021).

Ali, H. 2011. A comparison of cooperative learning and traditional lecture methods in the project management department of a tertiary level institution in Trinidad and Tobago. *The Caribbean Teaching Scholar*, 1(1): 39-60. Available:http://libraries.sta.uwi.edu/journals/ojs.index.php/cts/article/view/5 (Accessed:3 February 2020).

Alpi, K. M. and Evans, J. J. 2020. Distinguishing case study as a research method from case reports as a publication type. *Journal of the Medical Library Association: JMLA*, 107(1): 1Available: http://doi: 10.5195/jmla.2019.615 (Accessed: December 2021)

Arnold, M. L., Newman, J. H., Gaddy, B. B. and Dean, C. B. 2005. A look at the condition of rural education research: Setting a difference for future research. *Journal of Research in Rural Education, 20*(6). http://jrre.vmhost.psu.edu/wp-content/uploads/2014/02/20-6.pdf

Antwi, S. K. and Kasim, H. 2015. Qualitative and Quantitative Research Paradigms in Business Research: a Philosophical Reflection. *European Journal of Business Management,* 7(3): 217 - 226.

Appleton, K. 2015. How do beginning primary school teachers cope with science? Toward an understanding of science teaching practice. *Research in Science Education*, 32:1-25

Arshed, N. and Danson, M. 2015. The literature review. In: O'Gorman, K. and MacIntosh, R. eds. *Research methods for business and management.* London: Goodfellow Publishers Ltd, 31-49.

Assarroudi, A., Nabavi, F. H., Armat, M. R., Ebadi, A. and Vaismorodi, M. 2018. Directed qualitative content analysis: the description and elaboration of its underpinning methods and data analysis process. *Journal of Research in Nursing.* Available: https://doi.org/10.1177/1744987117741667. (Accessed: 4 June 2020).

Athanasiou, M. S., Geil, M., Hazel, C. E., and Copeland, E. P. 2002. A look inside school-based consultation: A qualitative study of the beliefs and practices of school psychologists and teachers. School Psychology Quarterly 17(3):258-298 Available: DOI:10.1521/scpq.17.3.258.20884

Azevedo, V., Carvalho, M., Fernandes-Costa, F., Mesquita, S., Soares, J., Teixeira, F. and Maia, Â. 2017. Interview transcription: conceptual issues, practical guidelines, and challenges. *Revista de Enfermagem Referência*, 4(14): 159-167. Available: https://www.redalyc.org/articulo.oa?id=388255675017 (Accessed: 13 April 2021).

Azis, A. 2015. Conceptions and practices of assessment: A case of teachers representing improvement conception. *Teflin Journal*, 26(2), 129-154. Available: http://dx.doi.org/10.15639/teflinjournal.v26i2/129-154 (Accessed: 13 May 2020)

Azure, J. A. 2015. Senior High School students' views on the teaching of Integrated Science in Ghana. *Journal of Science Education and Research*, 1(2), 49-61.

Baker, R. and Jones, A. 2005. How can international studies such as the international mathematics and science study and the programme for international student assessment be used to inform practice, policy and future research in science education in New Zealand?, *International Journal of Science Education,* 27:(2) 145-157. DOI: 10.1080/0950069042000276695 (Accessed: 18 June 2021)

Balthazard, C. 2015. 'What Does it Mean to be Professional'. HRPA Series on Professionalization, Professionalism, and Ethics for Human Resources Professionals. Conference Proceedings, Conference Proceedings. Central Queensland University: North Rockhampton, Australia. August 2015. Available:https://www.hrpa.ca/Documents/Designations/Job-Ready-Program/What-it-means-to-be-aprofessional.pdf (Accessed: 14 June 2021).

Bandura, A. 1978. *Social learning theory*. Englewood Cliffs, NJ: Prentice-Hall.

Barasua, L. A., Nwanekezi. A. U., and Chetta, W. 2018. Incorporating collaborative learning strategy as part of an integrated approach in teaching physics in secondary schools. *International Journal of Education, Learning and Development* 6(5):73-81.Available: https://www.eajournals.org (Accessed: 18 July 2021)

Barrett, A. M., and Bainton, D. 2016. Re-interpreting relevant learning: an evaluative framework for secondary education in a global language. *Comparative Education*, *52*(3), 392-407.Available: https://doi.org/10.1080/03050068.2016.1185271 (Accessed: 18 September 2020)

Bell, B. and Gilbert, J. 1996. *Teacher development: a model from science education.* London: Falmer.

Bekker, S. and Clark, A. 2018. Improving qualitative research findings presentations: insights from genre theory. *International Journal of Qualitative Methods*, 17: 1–10. Available: https://doi.org/10.1177/1609406918786335 (Accessed: 24 April 2021).

Bhengu, T. T. 2005. *Principals as professional leaders: implications for management of rural secondary schools during transition*. PhD, University of KwaZulu-Natal.

Bertram, C. 2014. Shifting discourses and assumptions about teacher learning in South African teacher development policy. *Southern African Review of Education*, 20(1): 90-108. Available: https://hdl.handle.net/10520/EJC155967 (Accessed: 20 October 2018).

Bertram, C. and Christiansen, I. 2020. *Understanding research*. *An introduction to reading research.* 2nd ed. Pretoria: Van Schaik Publishers.

Bertram, C., Mthiyane, N. and Mukeredzi, T. G. 2013. "It will make me a real teacher": Learning experiences of part time PGCE students in South Africa. *International Journal of Educational Development*, *33*(5), 448-456. Available: https://doi:10.1016/j.ijedudev.2012.10.001 (Accessed: 18 July 2020)

Biddle, C. and Azano, A. P. 2016. Constructing and Reconstructing the "Rural School Problem": A Century of Rural Education Research. *Review of Research in Education*, 40(1), 298–325. https://doi.org/10.3102/0091732X16667700 (Accessed: 25 July 2019).

Bignotti, A. and Roux, I. 2020. Which types of experience matter? The role of prior start-up experiences and work experience in fostering youth entrepreneurial intentions. *International Journal of Entrepreneurial Behaviour and Research,* 26(6): 1181 - 1198.

Blair, G., Imai, K. and Zhou, Y. Y. 2015. Design and analysis of the randomized response technique. *Journal of the American Statistical Association*, 110(511): 1304-1319. Available: https://doi.org/10.1080/01621459.2015.1050028 (Accessed: 25 July 2019).

Blease, B. 2014. Exploring writing practices in two foundation phase rural multi-grade classes. M.Ed, Cape Peninsula University of Technology, Cape Town.

Bloch, G. 2009. *The toxic mix: What's wrong with South Africa's schools and how to fix it*, Tafelberg, Cape Town. In Mukeredzi, T.G., Bertram, C. and Christiansen, I., 2018. 'Investigating teacher learning from a university programme for Foundation Phase teachers', *South African Journal of Childhood Education* 8(1), a524. Available: https://doi.org/10.4102/sajce.v8i1.524 (Accessed: 25 February 2019).

Bradshaw, C., Atkinson, S. and Doody, O. 2017. Employing a qualitative description approach in Health Care research. *Global Qualitative Nursing Research.* Available: https://doi.org/10.1177/2333393617742282.(Accessed: 16 September 2020).

Braun, V. and Clarke, V. 2012. Thematic analysis. In: Cooper, H. Camic, P. M., Long, D. L., Panter, A. T., Rindskopf, D. and Sher, K. J. eds. *APA handbook of research methods in psychology, vol. 2: Research designs: Quantitative, qualitative, neuropsychological, and biological*. Washington, DC: American Psychological Association, 57-71.

Brevik, L. M. 2013. Research ethics: an investigation into why school leaders agree or refuse to participate in educational research. *Problems of Education in the 21st Century*, 52: 7-20. Available: http://urn.nb.no/URN:NBN:no-34383 (Accessed: 31 March 2019).

Brink, R. 2018. A multiple case design for the investigation of information management processes for work-integrated learning. *International Journal of Work-Integrated Learning*, 19(3): 223-235.Available:https://www.ijwil.org/files/IJWIL193223_235.pdf (Accessed: 16 August 2021).

Brooks, R., te Riele, K. and Maguire, M. 2014. *Ethics and education research*. London: SAGE Publications.

Brown, C. S., Cheddie, T. N., Horry, L. F. and Monk, J. E. 2017. Training to be an early childhood professional: teacher candidates' perceptions about their education and training. *Journal of Education and Training Studies*, 5(6): 177-186.Available: https://doi.org/10.11114/jets.v5i6.2308 (Accessed: 28 October 2019).

Borg, S. 2003. Teacher cognition in language teaching: A review of research on what language teachers think, know, believe, and do. *Language Teaching, 36*(2), 81-109. Available: https://doi:10.1017/S0261444803001903 (Accessed: 25 July 2019).

Borg, S. 2013. The impact of in-service teacher education on language teachers' beliefs. In A. Burns, A. and Richards, J. C. (Eds.).*The Cambridge Guide to Second Language Teacher Education* (pp. 163-171). Cambridge University Press.

Borich, G. D. 2016. Observation skills for effective teaching: Research-based practice. Routledge. Available: https://doi.org/10.4324/9781315633206 (Accessed:15 July 2019).

Bowen, G. A. 2005. Preparing a qualitative research-based dissertation: Lessons learned. *The Qualitative Report, 10*(2), 208-222. Available: http://www.nova.edu/ssss/QR/QR10-2/bowen.pdf

Bowen, G. A. 2009. Naturalistic inquiry and the saturation concept: A research note. Qualitative Research, 8(1), 137-152.

Chai, C. S., Koh, J. H. L. and Tsai, C. C. 2013. A review of technological pedagogical content knowledge. *Journal of Educational Technology and Society*, *16*(2): 31-51.

Chan, K.K.H. and Yung, B. H.W. 2015. On-site pedagogical content knowledge development. *International Journal of Science Education*, *37*(8), 1246-1278.Available: https://doi.org/10.1080/09500693.2015.1033777

Cortes, K. E., Moussa, W. S. and Weinstein, J. M. 2012. Making the grade: The impact of classroom behavior on academic achievement. In *APPAM Fall Research Conference, Baltimore, MD* (pp. 8-10).

Council for Higher Education (CHE). 2010. *Annual report for Council for Higher Education: 2009/2010.* Pretoria: Department of Education

Cheetham, G. and Chivers, G. 2001. "How professionals learn in practice: an investigation of informal learning amongst people working in professions", Journal of European Industrial Training. 25(5): 248-292.

Chen, S., Chang, W.H., Lai, C.H. and Tsai, C.Y. 2014. A comparison of students' approaches to inquiry, conceptual learning, and attitudes in simulation-based and microcomputer-based laboratories. Sci Educ 98(5):905-935. Available: https://doi:10.1002/sce.21126 (Accessed: 25 April 2022).

Chisholm, L. 2019. *Teacher Preparation in South Africa: History, Policy and Future Directions.* Bingley: Emerald Publishing.

Chisholm, L. 2020. Landscapes of Teacher Education in South African History. In *Oxford Research Encyclopaedia of Education*. 1-15. University of Johannesburg.

Available:https://doi.org/10.1093/acrefore/9780190264093.013.1466.(Accessed:28 October 2021).

Coetzee, E. 2010. *Creative group music teaching and the principles of Gestalt Play Therapy in the foundation phase in South African education.* M.Mus, University of Stellenbosch.

Cogill, J. A. 2008. *Primary teachers' interactive whiteboard practice across one year: changes in pedagogy and influencing factors*. PhD Ed, King's College London.

Cohen-Sayag, E. and Fischl, D. 2012. Reflective writing in pre-service teachers' teaching: What does it promote? *Australian Journal of Teacher Education*, 37(10): 20-36. Available: https://search.informit.org/doi/10.3316/aeipt.198796 (Accessed: 30 October 2020).

Cohen, D. and Hill, H. 2000. Instructional policy and classroom performance: the mathematics reform in California. *Teachers College Record*, 102: 294-343. Available: https://files.eric.ed.gov/fulltext/ED417942.pdf (Accessed: 12 May 2019).

Cohen, L., Marrion, L. and Morrison, K. 2011. *Research Methods in Education* (7th ed.). London: Routledge.

Cohen, L., Marrion, L. and Morrison, K. 2017. *Research Methods in Education* (7th ed.). London: Routledge.

Cohen, L, Manion, L. and Morrison, K. 2018. *Research methods in education*. 8th ed. New York: Routledge.

Collins, E. M. S. and Calhoun, T. R. 2014. Raising the bar in freshman science education: Student lectures, scientific papers, and independent experiments. *Journal of College Science Teaching*, *43*(4), 26-35.

Colorafi, K. J. and Evans, B. 2016. Qualitative descriptive methods in health science research. *Health Environmental Research and Design Journal.* Available: https://doi.org/10.1177/1937586715614171. (Accessed: 14 April 2018).

Cooksey, R. and McDonald, G. 2011. *Surviving and thriving in postgraduate research,* Prahran: Tilde University Press.

Connelly, L. M. 2016. Trustworthiness in qualitative research. *Medsurg nursing: Official Journal of the Academy of Medical-Surgical Nurses,* 25(6): 435 - 436.

Costa, C., Cardoso, A. P., Lima, M. P., Ferreira, M. and Abrantes, J. L. 2015. Pedagogical Interaction and Learning Performance as Determinants of Academic Achievement, *Procedia - Social and Behavioural Sciences,* Volume 171: 874-881.Available: https://doi.org/10.1016/j.sbspro. (Accessed: 25 July 2019).

Cox, C. S. 2009. Understanding the college completion agenda on a community college campus: the lived experience of faculty and administrators. MSW, Oklahoma State University.

Creswell, J. 1998. Qualitative inquiry and research design: choosing among five traditions. London: SAGE Publications.

Creswell, J. W. 2002. *Educational research: planning, conducting, and evaluating quantitative*. Upper Saddle River: Prentice Hall.

Creswell, J. W. 2009. *Research design: quantitative and qualitative approaches.* Thousand Oaks: SAGE Publications.

Creswell, J. W. 2010. *Qualitative inquiry and research design*: *choosing among five traditions*. Thousand Oaks: SAGE Publications.

Creswell, J. W. 2012. *Qualitative inquiry and research design*: *choosing among five approaches*. Thousand Oaks: SAGE Publications

Creswell, J. W. 2007. *Qualitative Inquiry and Research Design: Choosing among five approaches* (2nd ed). Thousand Oaks, CA: Sage Publications, Inc.

Creswell, J.W. 2013. *Qualitative inquiry and research design: Choosing among five approaches.* Thousand Oaks, CA: Sage Publications, Inc.

Creswell, J.W. 2014. *Research design*: *Qualitative, Quantitative and Mixed Methods approaches* (4th ed). Thousand Oaks, CA: Sage Publications, Inc.

Cruickshank, D. R. and Haefele, D. 2014. "Good teachers, plural", Educational Leadership, 58, 26-30.

Cross, M. and Chisholm, L. 1990. The roots of segregated schooling in twentieth century South Africa. In: Nkomo, M. ed. *Pedagogy of domination: toward a democratic education in South Africa*. Trenton: Africa World Press, 43-74.

Cross, M., Klein, G. and Mkwanazi-Twala, Z. 1998. Dealing with diversity in South African Education. Cape Town: Juta

Cuddy, A. J. C., Caroline A. W. and Dana R. C. 2012. "The Benefit of Power Posing Before a High-Stakes Social Evaluation." *Harvard Business School Working Paper*, No. 13-27, September 2012.Available: http://nrs.harvard.edu/urn-3:HUL.InstRepos:9547823 (Accessed: 25 January 2019).

Dada, S. and Fadokun, J. B. 2010. Professional ethics into teaching: the training and development challenge. Philadelphia: Open University Press.

Dall'Alba, G. and Sandberg, J. 2006. Unveiling professional development: A critical review of stage models. *Review of educational research*, *76*(3), 383-412. Available: https://doi.org/10.3102/00346543076003383(Accessed: 20 July 2019).

Darling-Hammond, L. 2003. Recognizing and enhancing teacher effectiveness. *The International Journal of Educational and Psychological Assessment*, 3(1): 1–24. Available: https://sites.google.com/site/tijepa2012/home (Accessed: 3 March 2018).

Darling-Hammond, L., Hyler, M. E. and Gardner, M. 2017.*Effective professional development. Research brief.* Palo Alto: Learning Policy Institute. Available:https://learningpolicyinstitute.org/sites/default/files/productfiles/Effective_Teacher_Professional_Development_BRIEF.pdf (Accessed: 3 March 2018)

de Klerk, E. D. 2014. Teacher autonomy and professionalism: a policy archaeology perspective. PhD thesis: University of Stellenbosch, South Africa. Available: https://pdfs.semanticscholar.org/ffdb/a0a1a4376c0b9fb40d2b5ccac7c89d307a73.pdf. (Accessed: 28 November 2019).

de Vries, S., van de Grift, W.J.C.M. and Jansen, E.P.W.A. 2012.Teachers' beliefs and continuing professional development. Journal of Educational Administration. 51 (2):213-231 DOI: 10.1108/09578231311304715

De Wet, C. 2016. The status of teaching as a profession in South Africa. In: N. Popov, C. Wolhunter, J. Kalin, G. Hilton, J. Ogunleye, & E. Niemczyk (eds), Education

provision to everyone: Comparing perspectives from around the world. *BCES Conference Books*, 14(1): 143-149. Sofia: Bulgarian Comparative Education Society.

Diamond, B. S., Maerten-Rivera, J., Rohrer, R., and Lee, O. 2013. Elementary teachers' science content knowledge: Relationships among multiple measures. *Florida Journal of Educational Research*, *51*(1), 1-20.

Duit, R., Niedderer, H., Schecker, H. and Höttecke, D. 2014. Teaching Physics. Handbook of research on science education, Vol. II: 434-456. Routledge. Available:https://www.researchgate.net/publication/264942391_Teaching_Physics (Accessed: 20 July 2019).

Dunbar, C. 2014. Best Practices for classroom Management. *Alternative schooling for African American youth: Does anyone know we're here?* New York: Peter Lang.

Du Plessis, P. and Mestry, R. 2019. Teachers for rural schools–a challenge for South Africa. *South African Journal of Education*, 39: S1-S9. Available: https://doi.org/10.15700/saje.v39ns1a1774 (Accessed: 12 April 2020).

Education Labour Relations Council (ELRC) of South Africa. 2004. Collective Agreement No. 8 of 2003 27 August. Pretoria: Government Printers.

Eisner, E.W. 2012, "The kind of schools we need", Phi Delta Kappan, 83, 576-583.

Etikan, I., Musa, S. A. and Alkassim, R. S. 2016. Comparison of convenience sampling and purposive sampling. *American journal of theoretical and applied statistics*, *5*(1), 1-4. Available: https:// doi: 10.11648/j.ajtas.20160501.11. (Accessed: 25 June 2019).

Enslin, P. and Pendlebury, S. 1998. Transforming Education in South Africa? *Cambridge Journal of Education.* 28(3): 261-267.Available: https://doi.org/10.1080/0305764980280301 (Accessed: 25 July 2018).

Erten, İ. H. 2015. Age related gender differences in causal attributions of Turkish learners of English as a foreign language. *ELT Research Journal*, *4*(2), 129-146.

Erten, İ. H. Burden, R. L. 2014. The relationship between academic self-concept, attributions, and L2 achievement. System, 42, 391-401.

Evans, L. 2002. What is teacher development? *Oxford Review of Education,* 28(1) 123-137.

Falk, J. H. and Dierking, L.D. 2000. *Learning from museums: Visitor experiences and the making of meaning*. Walnut Creek, CA: Alta Mira Press.

Fareo, O. D. 2015. Professionalization of teaching in Nigeria: Strategies, prospects and challenges. *Journal of Education and Learning*, *9*(3), pp.190-196. Available:https://doi.org/10.11591/edulearn.v9i3.1801(Accessed:20 November 2021).

Farley, P.G. 2014. *Factors that affect the success of women administrators in higher education*. Doctoral Dissertation: University of Exeter.

Farooq, M. B. 2018. A review of Gadamerian and Ricoeurian hermeneutics and its application to interpretive accounting research. *Qualitative Research in Organizations and Management: An International Journal,* 13(3): 261-283. Available: www.emeraldinsight.com/1746-5648.htm (Accessed: 4 June 2021).

Farrell, T. S. and Ives, J. 2015. Exploring teacher beliefs and classroom practices through reflective practice: A case study. Language Teaching Research, 19(5), 594–610. Available: https://doi.org/10.1177/1362168814541722 (Accessed: 25 July 2018).

Feather, N.T. and Simon, J. G. (1971) Attribution of responsibility and valence of outcome in relation to initial confidence and success and failure of self and other. *Journal of Personality and Social Psychology*, 18, 173–188

Fischer, C., Fishman, B., Dede, C., Eisenkraft, A., Frumin, K., Foster, B. and McCoy, A. 2018. Investigating relationships between school context, teacher professional development, teaching practices, and student achievement in response to a nationwide science reform. *Teaching and Teacher Education*, *72*, 107-121. Available: https://doi.org/10.1016/j.tate.2018.02.011 (Accessed: 2 July 2020).

Fiske, E. and Ladd, H. 2004. *Elusive equity: Education reform in post-apartheid South Africa*. Washington, DC: Brookings Institution Press.

Fitzgerald, M., Danaia, L. and McKinnon, D. H. 2017. Barriers inhibiting inquiry-based science teaching and potential solutions: Perceptions of positively inclined early adopters. *Research in Science Education*, 49(2), 543-566. Available: https://doi.org/10.1007/s11165-017-9623-5 (Accessed: 25 May 2021).

Fleisch, B. 2008. *Primary education crisis*: *why South African schoolchildren underachieve in reading and mathematics.* Cape Town: Juta and Co.

Fleming, J. 2018. Methodologies, methods and ethical considerations for conducting research in work-integrated learning. *International Journal of Work-Integrated Learning,* 19(3): 205 - 213.

Flick, U. 2006. An introduction to qualitative research. 3rd ed. Thousand Oaks: SAGE Publications

Francis, J. J., Johnston, M., Robertson, C., Glidewell, L., Entwistle, V., Eccles, M.P. and Grimshaw, J.M. 2010. What is an adequate sample size? Operationalising data saturation for theory-based interview studies, *Psychology and Health*, 25(10):1229-1245, Available: DOI: 10.1080/08870440903194015

Fraser, C., Kennedy, A., Reid, L. and McKinney, S. 2007. Teachers' continuing professional development: Contested concepts, understandings and models. *Journal of in-service education*, *33*(2), 153-169. Available: https://doi.org/10.1080/13674580701292913 (Accessed: 28 June 2018)

Friedrichsen, P. J., Abell, S. K., Pareja, E. M., Brown, P. L., Lankford, D. M. and Volkmann, M. J. 2009. Does teaching experience matter? Examining biology teachers' prior knowledge for teaching in an alternative certification program. *Journal of Research in Science Teaching: The Official Journal of the National Association for Research in Science Teaching*, *46*(4):357-383.Available: https://doi.org/10.1002/tea.20283 (Accessed: 25 July 2018).

Furner, C. and McCulla, N. 2019. An exploration of the influence of school context, ethos and culture on teacher career-stage professional learning. *Professional development in education*, *45*(3), 505-519.Available: https://doi.org/10.1080/19415257.2018.1427134. (Accessed: 25 November 2021).

García, O., Johnson, S. I. and Seltzer, K. 2017. The translanguaging classroom: Leveraging student bilingualism for learning. Philadelphia, PA: Caslon.

García, O. and Otheguy, R. 2019. Plurilingualism and translanguaging: Commonalities and divergences. International Journal of Bilingual Education and Bilingualism. https://doi.org/10.1080/13670050.2019.1598932. (Accessed: 13 March 2021).

Gardiner, M. 2008. A report on education in rural areas (Issues in education Policy No.4) Retrieved from the Centre for Education Policy Development. Available: http://www.cepd.org.za/files/pictures/Education%20in%20Rural%20Areas%202008.pdf. (Accessed: 22 June 2018).

Gasson, S. 2004. Rigor in Grounded Theory Research: An Interpretive Perspective on Generating Theory from Qualitative Field Studies. In Whitman, M. and Woszczynski, A. (Eds.), *The Handbook of Information Systems Research* (pp. 79-102). IGI Global. Available: https://doi.org/10.4018/978-1-59140-144-5.ch006. (Accessed: 23 June 2018).

Georgiou, S.N., Christou, C., Stavrinides. P. and Panaoura, G. 2002. Teacher attributions of student failure and teacher behaviour toward the failing student. *Psychology in the schools, 39,583-595.*

Gergen, K. J. 1991. The saturated self. New York: Basic.

Gess-Newsome, J., Taylor, J.A., Carlson, J., Gardner, A. L., Wilson, C.D. and Stuhlsatz, M. A. M. 2019. Teacher pedagogical content knowledge, practice, and student achievement, *International Journal of Science Education,* 41:7, 944-963.Available: DOI: 10.1080/09500693.2016.1265158.

Goldkuhl, G. 2019. The generation of qualitative data in Information Systems Research: the diversity of empirical research methods. *Communications of the Association for Information Systems,* 44(28): 572 - 599.

Ghonsooly, B., Ghanizadeh, A., Ghazanfari, M. and Ghabanchi, Z. 2015. An exploration of EFL teachers' attributions. *European Journal of Teacher Education*, *38*(3), 378-391.https://doi.org/10.1080/02619768.2014.921155 (Accessed: 13 May 2018)

Gough, A. 2014. Beyond Eurocentrism in science education: Promises and problematics from a feminist poststructuralist perspective. In *Curriculum* (pp. 185-209). Routledge.

Gough, A. 2009. Editorial. Eurasia Journal of Mathematics, Science and Technology Education, 5(3): 183-185

Green, W. 2011. Foundation phase teacher provision by public higher education institutions in South Africa. *South African Journal of Childhood Education*, 1(1): 13. Available: https://doi.org/10.4102/sajce.v1i1.80 (Accessed: 3 March 2018).

Grey, S., Leow, R. P., Marijuan, S. and Moorman, C. 2014. Concurrent data elicitation procedures, processes, and the early stages of L2 learning: A critical overview. *Second Language Research*, *30*(2), 111-127. Available: https://doi.org/10.1177/0267658313511979 . (Accessed: 23 June 2019).

Grix, J. and Maguire, J. 2014. Political science and sport. *Social sciences in sport*, 191-218.

Grossman, P. 1990. *The making of a teacher. Teacher Knowledge and teacher education.* New York and London: Teachers College Press.

Grossman, P. L., Wilson, S. M. and Shulman, L. S. 1989. Teachers of substance: Subject matter knowledge for teaching. In M. C. Reynolds (Ed.), Knowledge base for the beginning teacher (pp. 22–36). Oxford: Pergamon.

Grussendorff, S., Booyse, C. and Elizabeth B. E. (2014). *What's in the CAPS package? Overview report*. Pretoria: Umalusi (Council for Quality Assurance in General and Further Education and Training). Available*:* https://www.umalusi.org.za/docs/reports/2014/overviewcomparative analysis.pdf.

Guba, E. G. and Lincoln, Y. S. 1994. Competing paradigms in qualitative research. In: Denzin, N. K and Lincoln, Y.S. eds. *Handbook of qualitative research*. 105-117. Thousand Oaks: SAGE Publications.

Gudyanga, R. and Jita, L. C. 2019. Teachers' implementation of laboratory practicals in the South African physical sciences curriculum. *Issues in Educational Research*, 29(3), 715-731. http://www.iier.org.au/iier29/gudyanga.pdf. (Accessed: 20 June 2020).

Gupta, S., Kaushik, M. and Garg, S. 2004. Networking and collaboration in open distance education. *Indian Journal of Open Learning, 13*(3): 293–302.

Gurney, P. 2007 "Five factors for effective teaching" *Journal of Teachers´ Work*, 4(2), 89-98

Guskey, T. R. 2009. *Evaluating professional development*. Thousand Oaks: Corwin Press.

Guskey, T. R. 2014. Professional development and teacher change. *Teachers and Teaching*, 8(3): 381-391.Available: https://doi.org/10.1080/135406002100000512 (Accessed: 7 July 2018).

Haklander, A. J., Siegmund, P. C. and Kelder, H. M. 2007. Interannual variability of the stratospheric wave driving during northern winter, Atmos. Chem. Phys., 7, 2575–2584. Available: https://doi.org/10.5194/acp-7-2575-2007, 2007. (Accessed: 20 June 2018).

Hammersley, M. and A. Traianou. 2012. Ethics and Educational Research, British Educational Research Association on-line Resource. *British Educational Research Association*. Available: http://www.bera.ac.uk/resources/ethicsand-educational-research. (Accessed: 10 September 2018)

Hargreaves, A. 2010. Cultures of teaching: A focus for change. In Hargreaves. A. and Fullan.M. (Eds.), *Understanding teacher development* (pp. 216-240). New York: Teachers College Press.

Hashweh, M. 1996. Effects of science teachers' beliefs in teaching. *Journal of Research in Science Teaching,* 33(1): 47–63. In Hashweh, M. 2013. Pedagogical content knowledge: Twenty-five years later. *Advances in Research on Teaching.* 19.115-140. DOI: 10.1108/S1479-3687 (2013)0000019009.

Hawkins, J. E. 2018. The practical utility and suitability of email interviews in qualitative research. *The Qualitative Report*, 23(2): 493-501.

Heider, F. 1958. The psychology of interpersonal relations. New York: Wiley.

Hlalele, D. 2012. Social justice and rural education in South Africa. *Perspectives in Education*, 30(1):111-118

Ho, V. T., Nakamori, Y., Ho, T. B. and Lim, C. P. 2016. Blended learning model on hands-on approach for in-service secondary school teachers: combination of E-learning and face-to-face discussion. *Education and Information Technologies*, 21(1): 185-208. Available: https://doi.org/10.1007/s10639-014-9315-y (Accessed: 24 May 2020).

Hoban, G. 2002. *Teacher learning for educational change*. Buckingham, UK: Open University Press.

Holmlund, T. D., Lesseig, K. and Slavit, D. 2018. Making sense of "STEM education" in K-12 contexts. *International Journal of STEM Education*, 5(1): 32. Available: https://doi.org/10.1186/s40594-018-0127-2 (Accessed: 20 September 2020).

Honey, M. and Hilton, M. eds. 2011. Learning science: computer games, simulations, and education. Committee on Science Learning. Available: http://www.nap.edu/ openbook.php?record_id=13078&page=R1.(Accessed: 16 June 2019).

Horn, I. S. and Little, J. W. 2010. Attending to Problems of Practice: Routines and Resources for Professional Learning in Teachers' Workplace Interactions. *American Educational Research Journal,* 47(1): 181–217.Available: https://doi.org/10.3102/0002831209345158. (Accessed: 23 June 2019).

Hornby, A. S. 2010. Oxford advanced learner's dictionary of current English. International student edition. 8th ed. New York: Oxford University Press.

Hugo, W., Jack, M., Wedekind, V. and Wilson, D. 2010. *The state of education in KwaZulu-Natal: A report to the Provincial Treasury*. Pietermaritzburg: KZN Provincial Treasury. In Mukeredzi, T.G. 2009. Exploring professional development experiences of the professionally unqualified teachers in rural secondary schools [unpublished Doctoral dissertation]. University of KwaZulu-Natal.

Human Sciences Research Council (HSRC). 2006. Emerging voices: a report on education in South African rural communities. Cape Town: Nelson Mandela Foundation.

Ilorah, R. 2006. The dilemma of the HBUs in South Africa. *South African Journal of Higher Education*, 20(3): 79-96. Available: https://hdl.handle.net/10520/EJC37252 (Accessed: 10 April 2018).

Ingersoll, R. and Perda, D. 2009.The Mathematics and Science Teacher Shortage: *Fact and Myth. CPRE Research Reports.* https://repository.upenn.edu/cpre_researchreports/51

Islam, F. 2012. Understanding pre-service teacher education discourses in communities of practice: a reflection from an intervention in rural South Africa. *Perspectives in Education*, 30(1): 19-29. Available: https://hdl.handle.net/10520/EJC87665 (Accessed: 23 May 2019).

Ismail, N., Kinchin, G. and Edwards, J. A. 2018. Pilot study, does it really matter? Learning lessons from conducting a pilot study for a qualitative PhD thesis. *International Journal of Social Science Research*, 6(1): 1-17. Available: https://doi.org/10.5296/ijssr.v6i1.11720 (Accessed: 18 January 2021).

Ivy, L. L.2013. Using humour in the classroom. *Education Digest, 10/2013, 79, Issue 2*

Jacob, F., Sakiyo, J. and Gwany, D.M. 2020. Motivation in Learning. *Asian Journal of Education and Social Studies* 10(4):16-37 Available: DOI:10.9734/AJESS/2020/v10i430273

Jacobs, M., Vakalisa, N.C.G and Gawe, N. 2011. Teaching-learning dynamics. Cape Town: Pearson.

Janes, K. H. 2021. Objects of curiosity: How old master paintings have been used in the primary classroom to provide pupils with cognitive challenge and creative agency. *Thinking Skills and Creativity*, *41*, 100861.

Jansen, J. and N. Taylor. 2003. Educational change in South Africa 1994–2003: Case studies in large-scale education reform. *Country Studies, Education Reform and Management Publication Series* 11(1): 1–51.

Jensen, J. L. 2011. Higher Education Faculty versus High School Teacher: Does Pedagogical Preparation Make a Difference? *Bioscene: Journal of College Biology Teaching*, *37*(2): 30-36.

Jimoyiannis, A. 2010. Designing and implementing an integrated technological pedagogical science knowledge framework for science teachers' professional development. *Computers and Education* 30: 1–11. doi:10.1016/j.compedu.2010.05.022

Jita, L. C. and Mokhele, M. L. 2014. When teacher clusters work: selected experiences of South African teachers with the cluster approach to professional development. *South African Journal of Education*, 34(2): 1-15. Available: https://doi.org/10.15700/201412071132 (Accessed: 19 April 2021).

Johansen, A., Little.S.G. and Akin-Little. A. 2011. An Examination of New Zealand Teachers' Attributions and Perceptions of Behaviour, Classroom Management, and the Level of Formal Teacher Training Received in Behaviour Management. *Journal. KAIRARANGA volume 12(2): 3-12*

Johnson, R. B. and Onwuegbuzie, A. J. 2004. Mixed Methods Research: A Research Paradigm Whose Time Has Come. Available: https://journals.sagepub.com/doi/10.3102/0013189X033007014 (Accessed: 20 June 2018).

Josephsen, J. and Hvidt, S. 2015. Experimental experience through project-based learning. In J. Garcia-Martinez and E. Serrano-Torregrosa (Eds.), Chemistry education: Best practices, opportunities and trends, ch.20, pp.489-516. Wiley-VCH. Available: https://digitalcommons.odu.edu/nursing_fac_pubs/24 (Accessed: 11 June 2020).

Julie, H., Bimray, P. and Jooste, K. 2019. Professionalism experiences of undergraduate learner nurses during their 4-year training programme at a higher education institution in the Western Cape, South Africa. *Curationis*, 42(1): 1-8. Available: https://hdl.handle.net/10520/EJC-1cd5da38ca (Accessed: 13 July 2020).

Kafyulilo, A. C. 2013 Professional Development through Teacher Collaboration: An Approach to Enhance Teaching and Learning in Science and Mathematics in Tanzania, *Africa Education Review,* 10:4, 671-688, DOI: 10.1080/18146627.2013.853560

Kamal, S.S.L.B.A. 2019. Research paradigm and the philosophical foundations of a qualitative study. *International Journal of Social Sciences,* 4 (3):1386 – 1394.

Karabenick, S. A. and Conley, A. (2011). Teacher motivation for professional development. *National science foundation. Ann Arbor: Math and Science Partnership - Motivation Assessment Program, University of Michigan.* Available: https://doi.org/10.1177/019263658206645804 (Accessed: 23 June 2018).

Kaushanskaya, M. and Crespo, K. 2019. Does Exposure to Code-Switching Influence Language Performance in Bilingual Children? *Journal for Society for Research in Child Development.* Volume 90(3):708-718. Available*:* https://doi.org/10.1111/cdev.13235. (Accessed: 2 June 2021).

Kavenuke, P. S. and Muthanna, A. 2021. Teacher educators' perceptions and challenges of using critical pedagogy: A case study of higher teacher education in Tanzania, *Journal of University Teaching & Learning Practice*, 18(4), 2021.Available: https://ro.uow.edu.au/jutlp/vol18/iss4/10 (Accessed: 22 April 2022).

Kaya, E. 2013. Argumentation practices in classroom: Pre-service teachers' conceptual understanding of chemical equilibrium. International Journal of Science Education, 35(7): 1139–1158. Available: https://doi:10.1080/09500693.2013.770935. (Accessed: 22 June 2019).

Kelder, K. H. 2008. Study and Master Physical Science, Grade 11. Cape Town: Cambridge University Press.

Kelley, H. H. 1967. Attribution theory in social psychology. In *Nebraska symposium on motivation*. University of Nebraska Press.

Kelly, P. 2006. What is teacher learning? A socio-cultural perspective. *Teaching and teacher education*, 18: 229 - 241.

Kennedy, M. M. 2016. How does professional development improve teaching?. *Review of educational research*, *86*(4): 945-980.Available: https://doi.org/10.3102/0034654315626800 . (Accessed: 14 June 2020).

Kgomo, M. E. 2013. *An exploration of foundation phase teachers' knowledge of handwriting in the Limpopo Province*. M.Ed., University of the Witwatersrand.

Khumalo, B. and Mji, A. 2014. Exploring Educators' Perceptions of the Impact of Poor Infrastructure on Learning and Teaching in Rural South African Schools. *Mediterranean Journal of Social Sciences*, *5*(20): 1521.

Available: https://www.richtmann.org/journal/index.php/mjss/article/view/3888

Kim, B. 2001. Social constructivism. *Emerging perspectives on learning, teaching, and technology*, *1*(1), 16. Available: http://www.coe.uga.edu/epltt/impaticas/social_constructivism_script.doc

Kimani, G.N., Kara, A. M. and Njagi, L.W. 2013. Teacher Factors Influencing Students' Academic Achievement in Secondary schools in Nyandarua County, Kenya. *International Journal of Educational Research.* 1(3):1-14.

Kind, V. 2014. Science teachers' content knowledge. In H. Venkat, M. Rollnick, J. Loughran, and M.Askew (Eds.), Exploring mathematics and science teachers' knowledge: Windows into teacher thinking (pp. 15–23). London: Routledge.

Kini, T. and Podolsky, A. 2016. *Does Teaching Experience Increase Teacher Effectiveness? A Review of the Research* (Palo Alto: Learning Policy Institute). Available: https://doi.org/10.54300/625.642.

Kinyota, M. and Kavenuke, P.S. 2018. Whose Name Are in Science Textbooks? Justifying the Need for Critical Pedagogy in Tanzania Science Classrooms. *Journal of Education, Humanities and Sciences,* 7(1): 31–44. Available: https://ro.uow.edu.au/jutlp/vol18/iss4/10 . (Accessed: 22 July 2021).

Kivunja, C. and Kuyini, A.B. 2017. Understanding and applying research paradigms in educational contexts. *International Journal of Higher Education,* 6(5): 26 – 41.

Koehler, M. and Mishra, P. 2009. What is Technological Pedagogical Content Knowledge (TPACK)? *Contemporary Issues in Technology and Teacher Education, 9*(1), 60-70. Waynesville, NC USA: Society for Information Technology & Teacher Education. Available: https://www.learntechlib.org/primary/p/29544/.(Accessed: 28 June 2019).

Kriek, J. and Grayson, D. 2009. A holistic professional development model for South African physical science teachers. *South African Journal of Education,* 29:185-203.

Kulinna, P.H. 2009.Teachers' Attributions and Strategies for Student Misbehaviour. *Journal of classroom Interaction. 42(2):21-30*

Kumar, R. 2018. *Research methodology*: *a step-by-step guide for beginners*. London: SAGE Publications.

Korstjens, I. and Moser, A. 2017. Series: practical guidance to qualitative research. Part 2: context, research questions and designs. *European Journal of General Practice*, 23(1): 274-279. Available: https://doi.org/10.1080/13814788.2017.1375090 (Accessed: 15 January 2021).

Kwakman, K. 2003. "Factors affecting teachers' participation in professional learning activities". Teaching and Teacher Education. 19 (2):149-170.

Legotlo, M. W., Maaga, M. P. and Sebego, M. G. 2002. Perceptions of stakeholders on causes of poor performance in Grade 12 in a province in South Africa. *South African journal of education*, *22*(2): 113-118.

Leitz, C.A. and Zayas, L.E. 2010. Evaluating qualitative research for social work practitioners. *Advances in Social Work,* 11(2): 188 - 202.

Le Janssen, H. J. and Wubbels, T. 2018. Collaborative Learning Practices: Teacher and Student Perceived Obstacles to Effective Student Collaboration. *Cambridge Journal of Education,* 48: 103-122. Available: https://doi.org/10.1080/0305764X.2016.1259389. (Accessed: 3 August 2021).

Levitt, K. E. 2002. An analysis of elementary teachers' beliefs regarding the teaching and learning of science. *Science education*, *86*(1):1-22. Available: https://doi.org/10.1002/sce.1042 . (Accessed: 22 June 2018).

Lewin, K., Samuel, M. and Sayed, Y. 2003. Changing Patterns of Teacher Education in South Africa: Policy, Practice and Prospects .Sandown: Heinemann.

Lieberman, A. and Miller, L. 2000. Teaching and Teacher Development: A New Synthesis for A New Century. In *Education in a New Era*, Brandt, R. (ed.), pp. 47-66.

Lincoln, Y.S. and Guba, E.G. 2013. The Constructivist Credo. California: Walnut Creek.

Little, S. G. and Akin-Little, K. A. 2011. Psychology's contributions to classroom management. *Psychology in the Schools*, 45: 227-234.

Lovett, S. and Gilmore, A. 2003 Teachers learning journeys: The quality learning circle as a model of professional development. *School Effectiveness and School Improvement,* 14(2): 189-212.

Low, D. E. and Pandya, J. Z. 2019. Issues of validity, subjectivity, and reflexivity in multimodal literacy research and analysis. *Journal of Language and Literacy Education*, 15(1): 1-22. Available:http://jolle.coe.uga.edu/wpcontent/uploads/2019/04/LowPandyaJoLLE2019.pdf (Accessed: 20 January 2021).

Luan, W.S., Atan, H. and Sabudin, S. 2010. Exploring teachers' perceptions of their pedagogical role with computers: a case study in Malaysia. *Procedia Social and Behavioural Sciences* 2:388–391. Available: https://www.sciencedirect.com (Accessed 13 June 2018)

Luft, J. 2009. Beginning secondary science teachers in different induction programmes: the first year of teaching. In Mavhunga, E. and Rollnick, M. 2015.Teacher- or Learner-Centred? Science Teacher Beliefs Related to Topic Specific Pedagogical Content Knowledge: A South African Case Study. *Article in Research in Science Education.* Available: https://www.researchgate.net/publication/287377527. (Accessed: 22 June 2019).

Luft, J., Firestone, J. B., Wong, S. S., Ortega, I., Adams, K. and Bang, E. 2011. Beginning secondary science teachers' induction: a two-year mixed methods study. Journal of Research in Science Teaching, 48(10): 1199–1224.

Lyakurwa, S. E. 2012. Teachers' Causal Attributions for Academic Underachievement in Public Secondary Schools in Tanzania. *A Journal of Contemporary Research*, 9(2):11-27

Madonsela, S. 2016. The pedagogical enhancement of classroom interaction through the use of code switching in multilingual classrooms in South Africa. *Journal of Educational Studies* . (15) 1: 126-146. Available: https://hdl.handle.net/10520/EJC199578.

Maende, J. B., Luvai, O. N. and Mbayah, J. T. 2014. Influence of teacher professional development on the use of educational resources in public secondary schools in Kenya. *International Journal of Education and Research*, 2(4): 99-112. Available: https://www.ijern.com/journal/April-2014/10.pdf (Accessed: 19 July 2017).

Magnaye-Laylo, L. 2020. Technological management efficiency on higher educational institutions towards organizational performance. *Asia Pacific Journal of Academic Research in Social Sciences*, *5*(2): 35-51. Available:https://research.lpubatangas.edu.ph/wp-content/uploads/2021/01/APJARSS-2020-5-004.pdf (Accessed: 22 January 2021).

Mahlaela, K. I. 2011. Teacher assessment (IQMS) for teacher professional development. M.Ed., University of Stellenbosch.

Maistry, S. 2014. Education for economic growth: A neoliberal fallacy in South Africa! Alternation, 21(1):57–75. Available:http://alternation.ukzn.ac.za/Files/docs/21.1/alternation%2021,1%20(2014).pdf#page=62. (Accessed 30 November 2019).

Majid, U. 2018. Research fundamentals: study design, population, and sample size. *Undergraduate Research in Natural and Clinical Science and Technology Journal*, 2: 1-7. Available: https://doi.org/10.26685/urncst.16 (Accessed: 29 January 2020).

Makgato, M. and Mji, A. 2006. Factors associated with high school learners' poor performance: a spotlight on Mathematics and Physical Science. *South African Journal of Education,* 26 (2):253-266. Available*:*http://www.sajournalofeducation.co.za/index.php/saje/article/view/80. (Accessed 24 September 2018)

Makombe, G. 2017. An expose of the relationship between paradigm, method and design in research. *The Qualitative Report,* 22(12): 3363 – 3382.

Maphoso, L.T. and Mahlo, D. 2015.Teacher Qualifications and Pupil Academic Achievement. *Journal of Social Sciences* 42(1-2):51-58 DOI:10.1080/09718923.2015.11893393

Marais, P. 2016. "We can't believe what we see": overcrowded classrooms through the eyes of student teachers. *South African Journal of Education*, 36(2): 1-10. Available: https://hdl.handle.net/10520/EJC189909 (Accessed: 2 July 2020).

Maree, N. and Vos, D. 2021. The influence and value of science and technology in the education systems of South Africa and Russia. *Perspectives in Education*, *39*(4): 27-42. https://doi.org/10.18820/2519593X/pie.v39.i4.3 (Accessed 24 September 2018)

Masinire, A. 2015. Recruiting and retaining teachers in rural schools in South Africa: insights from a rural teaching experience programme. *Australian and International Journal of Rural Education*, 25(1): 2-14. Available: https://journal.spera.asn.au/index.php/AIJRE/article/view/91 (Accessed: 23 July 2021)

Mathew, P., Mathew, P. and Peechattu, P. J. 2017. Reflective practices: A means to teacher development. *Asia Pacific Journal of Contemporary Education and Communication Technology*, 3(1), 126-131.

Mavhunga, E. and Rollnick, M. 2015.Teacher- or Learner-Centred? Science Teacher Beliefs Related to Topic Specific Pedagogical Content Knowledge: A South African Case Study. *Article in Research in Science Education.* Available:https://www.researchgate.net/publication/287377527. (Accessed 24 September 2021)

McMillan, J.H. and Schumacher, S. 2006. *Research in Education, Evidence based inquiry.* New Jersey: Pearson Educational International.

Merriam, S. B. 2009. Dealing with validity, reliability, and ethics in Qualitative research: A guide to design and implementation (pp. 209–235). San Francisco, CA: Jossey-Bass.

Middlewood, D., Parker, R. and Beere, J. 2013. *Creating a Learning School.* London: Paul Chapman Publications.

Miller, K. and Satchwell, C. 2006. The effect of beliefs about literacy on teacher and student expectations: A further education perspective. *Journal of Vocational Education and Training*, *58*(2): 135-150. Available:https://doi.org/10.1080/13636820600799551 (Accessed 22 September 2018)

Mitchel, L. Z. 2013. Everyone teaches and everyone learns: The professional development school way. R&L Education.

Moletsane, R. 2012. *Repositioning educational research on rurality and rural education in South Africa: Beyond deficit paradigms. Journal, perspectives in Education, vol 30(1), March 2012*

Moore, A. 2013. *Teaching and learning: Pedagogy, curriculum and culture*. Oxon: Routledge.

Moore-Cox, A. (2017). Lesson plans: Road maps for the active learning classroom. *Journal of Nursing Education, 56*(11): 697-700. Available: https://doi: http://dx.doi.org/10.3928/01484834-20171020-12 (Accessed 13 September 2020)

Morrison, J., Nelson, J. and Whitson, L. 2015. "Piloting a blended model for sustainable IL programming", *Reference Services Review*, Vol. 43 No. 1: pp. 137-151. Available: https://doi.org/10.1108/RSR-09-2014-0040 (Accessed 24 September 2019)

Mortari, L. 2015. Reflectivity in research practice: an overview of different perspectives. *International Journal of Qualitative Methods*, 14(5): 1-9. Available: https://doi.org/10.1177/1609406915618045 (Accessed: 18 November 2019).

Mosoge, M. J. and Pilane, M. W. 2014. Performance management: the neglected imperative of accountability systems in education. *South African Journal of Education*.34(1): 1-18. Available: DOI**:** 10.15700/201412120947

Mosston, M. and Ashworth, S. 2013. Teaching physical education. (5 th Ed.). San Francisco, CA: Benjamin Cummings.

Motloung, A. N., Mavuru, L. and McNaught, C. 2021. Teachers' beliefs and practices when teaching life sciences using their second language. *South African Journal of Education*, *41*(sup1): 1-15. Available: https://doi.org/10.15700/saje.v41ns1a2005 (Accessed 24 February 2022)

Mthiyane, N. 2016. Pre-service teachers' beliefs and experiences surrounding the use of language in science classrooms: A South African case study. *Nordic Journal of African Studies*, *25*(2): 19-19. Available: https://doi.org/10.53228/njas.v25i2.112 (Accessed 24 September 2020)

Mthiyane, N., Naidoo, J. and Bertram, C. 2018. Balancing monitoring and support: The role of HODs in curriculum coverage. In: Christie, P. and Monyokolo M. (eds.), *Learning*

about sustainable change in education in South Africa: The Jika iMfundo campaign 2015–2017 (pp. 169–195). Johannesburg: Saide.

Mudavanhu, Y. 2017. Quality of literature review and discussion of findings in selected papers on integration of ICT in teaching role of mentors, and teaching science through science, technology, engineering, and mathematics (STEM), *Educational Research and Reviews,* 12 (4): 189 – 201.

Mukeredzi, T.G. 2009. Exploring professional development experiences of the professionally unqualified teachers in rural secondary schools [unpublished Doctoral dissertation]. University of KwaZulu-Natal.

Mukeredzi, T.G. 2012. Qualitative data gathering challenges in a politically unstable rural environment: a Zimbabwean experience. *International Journal of Qualitative Methods,* 11(1): 1 - 12

Mukeredzi, T.G. 2013. The journey to becoming teaching professional in rural South Africa and Zimbabwe. *Australian Journal of Teacher Education,* 38(10).

DOI 10.14221/ajte.2013v38n10.6. (Accessed 10 September 2020).

Mukeredzi, T.G. 2015. Creating space for Pre-service Teacher Professional Development during Practicum: A Teacher Educator's Self-study. *Australian Journal of Teacher Education,* 40(2): 125 - 145.

Mukeredzi, T.G. 2019. Curriculum Framework development as space for lecturer professional learning: a teacher educator's self-study. *Journal of Adult and Continuing Education,* 25 (2): 267 – 289.

Mukeredzi, T.G. 2020. An exploration of workplace learning of centre managers and educators in South African adult education and training centres. *Journal of Adult and Continuing Education*. Available: https://doi.org/10.1177/1477971420976148. (Accessed 24 September 2021)

Mukeredzi, T. G. 2021. Teacher preparation for rurality: a cohort model of teaching practice in a rural South African School (In White, S. and Downey, J. (eds). *Rural Education across the World,* DOI: 978-981-33-6115-7. (Accessed 19 March 2021).

Mukeredzi, T.G. and Manwa, L. 2019. Inside mentor-mentee meetings in pre-service teacher school based teaching practice in Zimbabwe. *Australian Journal of Teacher Education,* 44(7): 31 - 52.

Mukeredzi, T.G. and Nyachowe, M. 2018. The content and evolution of practical theories of teaching: Experiences of professionally unqualified teachers in rural Zimbabwe secondary schools. *Sage Open Publications,* 1 - 18. Doi.10.1177/2158 244018785410. (Accessed 21 June 2020).

Mumhure, G. 2017. Zimbabwean teachers' perspectives on the history subject panels as an innovation for professional development. PhD, University of the Free State.

Musau, L. M., Migosi, J. and Muola, J. M. 2013. Determinants of girls' performance in science, mathematics and technology subjects in public secondary schools in Kenya. *International Journal of Educational Administration and Policy Studies*. 5(3):33-42. DOI: 10.5897/IJEAPS2012. 035

Muthén, L. K. and Muthén, B. (2010). Growth modeling with latent variables using Mplus: Introductory and intermediate growth models. *Mplus Short Course Topic*, *3*. http://www.statmodel.com/ (Accessed 24 September 2018)

Murphy, P. K., Greene, J. A., Firetto, C. M., Li, M., Lobczowski, N. G., Duke, R. F. and Croninger, R. M. 2017. Exploring the influence of homogeneous versus heterogeneous grouping on students' text-based discussions and comprehension. *Contemporary Educational Psychology*, *51*: 336-355. Available: https://doi.org/10.1016/j.cedpsych.2017.09.003 (Accessed 23 September 2020)

Nespor, J. 1987. The role of beliefs in the practice of teaching. *Journal of Curriculum Studies*, *19*(4): 317-328. Available: https://doi.org/10.1080/0022027870190403 (Accessed 24 September 2018)

Niedderer, H. and Schecker, H. 2015. Contrastive teaching: a strategy to promote qualitative conceptual understanding. *Improving Teaching and Learning in Science and Mathematics*. 141-151.New York: Teachers College Press

Nixon, R. S., Campbell, B. K., and Luft, J. A. 2016. Effects of subject-area degree and classroom experience on new chemistry teachers' subject matter knowledge. *International*

Journal of Science Education, *38*(10): 1636-1654.Available: https://doi.org/10.1080/09500693.2016.1204482 (Accessed: 18 June 2020)

Nkambule, T., Balfour, R. J., Pillay, G. and Moletsane, R. 2011. Rurality and rural education: discourses underpinning rurality and rural education research in South Africa post graduate education research 1994–2004. *South African Journal of Higher Education*, 25(2): 341-357. Available: https://hdl.handle.net/10520/EJC37678 (Accessed:30 November 2018).

Nkambule, T. and Mukeredzi, T. G. 2017. Pre-service teachers' professional learning experiences during rural teaching practice in Acornhoek, Mpumalanga Province. *South African Journal of Education*, 37(3): 1-9. Available: https://hdl.handle.net/10520/EJC-9d7db84cc (Accessed: 5 September 2018).

Nkhoma, B. P. 2010. Redefining professionalism and education for librarians in Zambia. *Zambia Library Association Journal*, 25(1): 69-84. Available: https://journals.co.za/doi/pdf/10.10520/AJA0049853X_518 (Accessed: 17 November 2020).

Obama, B. 2009. The five pillars of education. *.A speech to the U.S. Hispanic Chamber of Commerce on March 10, 2009.*

Oduaran, A. and Bechuke, A. L. 2018. Bridging the knowledge gap of South African first year students in the transition from high school to university. Available: https://www.researchgate.net/publication/338450144 (Accessed: 24 September 2019)

OECD. 2009. Creating Effective Teaching and Learning Environments: First Results from TALIS, Organisation for Economic Co-operation and Development, Paris.

Ogunniyi, M. 2011. Science and indigenous knowledge in the melting pot: Prospects and challenges. *International Journal of Science Education*, *29(8),* 963-986.

Okoye, N. S. 2009. The Effect of Gender, Socio-Economic Status and School Location on Students Performance in Nigerian Integrated Science. *Education*, *129*(3).

Olaleye, F.O. 2011. Teacher characteristics As Predictor of Academic Performance of Students in Secondary Schools in Osun State –Nigeria. *European Journal of Educational Studies.* 3(3):505 -511.

Ono, Y. and Ferreira, J. 2010. A Case Study of Continuing Teacher Professional Development through Lesson Study in South Africa. *South African Journal of Education* 30: 59 - 74.

O'reilly, M. and Parker, N. 2013. 'Unsatisfactory Saturation': a critical exploration of the notion of saturated sample sizes in qualitative research. *Qualitative research*, *13*(2), 190-197.Available: https://doi.org/10.1177/1468794112446106 (Accessed: 24 September 2019)

Owen, G. T. 2014. Qualitative Methods in Higher Education Policy Analysis: Using Interviews and Document Analysis. *The Qualitative Report*, *19*(26): 1-19.Available: https://doi.org/10.46743/2160-3715/2014.1211 (Accessed: 22 August 2018)

Owusu-Fordjouri, C. 2021. Attitude of teachers and its impact on their instructional practice. *European Journal of Education Studies* 8(8):163-176. Available:DOI:10.46827/ejes.v8i8.3845

Özdemir, N. 2020. How to improve teachers' instructional practices: the role of professional learning activities, classroom observation and leadership content knowledge in Turkey. *Journal of Educational Administration,* 58(6): 585-603. Available: https://www.emerald.com/insight/0957-8234.htm (Accessed: 3 August 2021).

Oyoo, S.O. 2017. Learner outcomes in science in South Africa: Role of the nature of learner difficulties with the language for learning and teaching science. Research in Science Education, 47:783– 804. Available: https://doi.org/10.1007/s11165-016-9528-8 (Accessed 24 May 2020)

Padgett, D. 2008. *Qualitative methods in social work research.* Los Angeles: SAGE Publications.

Paine, L. 2013. Exploring the Interaction of Global and Local in Teacher Education: Circulating Notions of What Preparing a Good Teacher Entails. In: Zhu, X., Zeichner, K. (eds) Preparing Teachers for the 21st Century. *New Frontiers of Educational Research. Springer, Berlin, Heidelberg*. https://doi.org/10.1007/978-3-642-36970-4_8 (Accessed: 24 July 2018)

Pajares, F. 2003. Self-efficacy beliefs, motivation, and achievement in writing: a review of the literature, Reading & Writing Quarterly, 19 (2); 139-158. Available: DOI: 10.1080/10573560308222

Pandey, S. C. and Patnaik, S. 2014. Establishing reliability and validity in qualitative inquiry: a critical examination. *Jharkhand Journal of Development and Management Studies*, 12(1): 5743-5753. Available: http://www.xiss.ac.in/JJDMS/about.php (Accessed: 18 August 2018).

Parker, B. 2001. Roles and responsibilities, institutional landscapes and curriculum mindscapes: a partial view of teacher education policy in South Africa, 1990–2000. *Paper presented at the Multi-Site Teacher Education Research (MUSTER) project conference*, Department of international development: Pretoria, 5–7 April.

Parker, B. 2003. Roles and responsibilities, institutional landscapes and curriculum mindscapes: A partial view of teacher education policy in South Africa: 1990 to 2000. In: Lewin, K. Samuel, M. and Sayed, Y. (Eds.), *Changing patterns of teacher education in South Africa: Policy, practice and prospects,* Sandown: Heinemann Publishers, 16-44.

Patton, M. Q. 2002. Qualitative research and evaluation methods (3rd ed.). Thousand Oaks, CA: Sage.

Peacock, M. 2009. Attribution and learning English as a foreign language. ELT Journal, 64(2): 184-193.

Peat, G., Rodriguez, A. and Smith, J. 2019. Interpretive phenomenological analysis applied to healthcare research, *Evidence-Based Nursing,* 22 (1): 7-9. Available: http://eprints.whiterose.ac.uk/140586. (Accessed: 19 May 2021).

Peterson, S. S. 2012. Action research supporting students' oral language in Northern Canada schools: a professional development initiative: *Journal of Research in Rural Education*, 27(10): 1-17. Available: http://jrre.psu.edu/articles/27-10.pdf (Accessed: 28 June 2019).

Petrie, J.A.C. and van der Zanden. 2013. *Teachers' attribution style, self-efficacy beliefs and their beliefs about differentiation*. SRC 2013 November, Amsterdam, Netherlands.

Pishghadam, R. and Motakef, R. 2011. Attributional patterns with respect to major and attendance in private language schools: A case of EFL context. *Theory and Practice in Language Studies* 1(7) :888-894.

Polit, D.F. and Beck, C.T. 2014. *Essentials of nursing research: appraising evidence for nursing practice* (8th ed). Philadelphia: Wolters Kluwer Health.

Prinsloo, C., Rogers, S.C. and Harvey, J. 2018. The impact of language factors on learner achievement in Science. South African Journal of Education. 38: 1-14. Available: http://dx.doi.org/10.15700/saje.v38n1a1438 (Accessed: 24 May 2020)

Probyn, M. 2009. 'Smuggling the vernacular into the classroom': conflicts and tensions in classroom code switching in township/rural schools in South Africa. *International Journal of Bilingual Education and Bilingualism*, *12*(2): 123-136.Available: https://doi.org/10.1080/13670050802153137 (Accessed: 14 May 2018)

Prosser, M. and Trigwell, K. 2009. *Understanding learning and teaching: the experience in higher education.* Buckingham, UK: Society for Research into Higher Education and Open University Press.

Rafail, P. 2017. Nonprobability sampling and twitter: strategies for semi-bounded and bounded populations. *Social Science Computer Review.* Available: https://doi.org/10.1177/0894439317709431 (Accessed: 18 March 2020).

Ramnarain, U. and Hlatswayo, M. 2018. Teacher beliefs and attitudes about inquiry-based learning in a rural school district in South Africa. South African Journal of Education, 38(1).Available: http://dx.doi.org/10.15700/saje.v38n1a1431 (Accessed: 12 May 2020).

Ramos, J. and Luzano, M. S. 2018. Seven personal qualities of senior high school teacher and linking support with their student. *International Journal of Social Sciences and Humanities*, *3*(2): 74-80.

Reeves, J. and Forde, C. 2004. The social dynamics of changing practice, *Cambridge Journal of Education,* 34(1): 85-102.

Riemer, B. S. 1975. Influence of causal beliefs on affect and expectancy. *Journal of Personality and Social Psychology, 31*(6):1163–1167. Available: https://doi.org/10.1037/h0077103 (Accessed: 18 June 2018).

Riley, T. and Ungerleider, C. 2012. *Self-fulfilling Prophecy: How Teachers' Attributions, Expectations, and Stereotypes Influence the Learning Opportunities Afforded Aboriginal Students. Canadian Journal of Education* 35(2): 303-333

Robinson, S. and Kerr, R. 2015. Reflexive conversations: constructing hermeneutic designs for qualitative management research. *British Journal of Management*, 26: 777-790. Available: https://doi.org/10.1111/1467-8551.12118 (Accessed: 11 September 2020).

Roehrig, G.H. and Kruse, R. A. 2015. The role of teachers' beliefs and knowledge in the adoption of a reform-based curriculum. *School Science and Mathematics*, 105:412-422.

Rollnick, M. and Mavhunga, E. 2015.Teacher- or Learner-Centred? Science Teacher Beliefs Related to Topic Specific Pedagogical Content Knowledge: A South African Case Study. *Res Sci Educ* 46: 831–855 Available: https://doi.org/10.1007/s11165-015-9483-9 (Accessed: 18 March 2020).

Roodt, M. 2018. The South African Education Crisis: Giving power back to parents. South African Institute of Race Relations (IRR). Richmond, Johannesburg. Available: https://irr.org.za/ southafrican education crisis

Rubio, C. M. 2010. "Effective teachers –Professional and personal skills". http://www.uclm.es/ab/educacion/ensayos (Accessed: 13 June 2020).

Saracho, O. (Ed.). 2014. Handbook of Research Methods in Early Childhood Education-Volume 2: *Review of Research Methodologies*.

Saiduddin, J. 2013. Factors affecting achievement at junior high school on the Pine Ridge Reservation. Spain: Ohio State University.

Saks, M. 2012. Defining a profession: The role of knowledge and expertise. *Professions and Professionalism*, 2(1). Available: https://doi.org/10.7577/pp.v2i1.151 (Accessed: 10 November 2020).

Sandelowski, M. 1986. The problem of rigor in qualitative research. *Advances in Nursing Science*, 8(3): 27-37. Available:https://psycnet.apa.org/doi/10.1097/00012272-198604000-00005 (Accessed: 16 August 2020).

Sayed, Y. 2004. The case of teacher education in post-apartheid South Africa: Politics and priorities. In *Changing class: Education and social change in post-apartheid South Africa,* ed. L. Chisholm, 247–265. London: Zed Books.

Scott, P., Asoko, H. and Leach, J. 2007. Student conceptions and conceptual learning in science. In Abell, S.K., and Lederman, N.G. (Eds.), *Handbook of research on science education* (pp. 31–56). Mahwah, NJ: Lawrence Erlbaum.

Scotland, J. 2012. Exploring the philosophical underpinnings of research: reading ontology and epistemology to the methodology and methods of the scientific, interpretive, and critical research paradigms. *English Language Teaching,* 5(9): 6 – 16.

Seidman, I. 1998. *Interviewing as qualitative research. A guide for researchers in education and social sciences.* New York: NY Teachers' College Press.

Seidman, I. 2015. *Interviewing as qualitative research: A guide for researchers in the social sciences and education.* 3rd ed. New York: Teacher's College, Columbia University Press.

Semeon, N. and Mutekwe, E. 2021.Perceptions about the use of language in physical science classrooms: A discourse analysis. *S. Afr. j. educ.* [online]. 2021, vol.41, n.1 pp.1-11. Available: http://dx.doi.org/10.15700/saje.v41n1a1781. (Accessed: 8 March 2022).

Serdyukov, P. 2017. "Innovation in education: what works, what doesn't, and what to do about it?", *Journal of Research in Innovative Teaching & Learning*, 10 (1):4-33. Available: https://doi.org/10.1108/JRIT-10-2016-0007 (Accessed: 13 March 2020).

Simon. S. and Campbell. S. 2012. Teacher Learning and Professional Development in Science Education. *Springer International Handbooks of Education 24: 307-321,* DOI 10.1007/978-1-4020-9041-7_22,

Siti, R.M.A. 2018. Ethical considerations in qualitative study. *International Journal of Care Scholars,* 1(2): 30 - 37.

Sithole, B. M. 2020. Teacher professional learning in business education: mapping the terrain. *Academic Research International,* 11(2): 41-53. Available: https://journals.savap.org.pk/vol11n2.html (Accessed: 11 June 2021).

South African Council of Educators (SACE). 2010. *Handbook for the code of professional ethics*. Durban: South African Council of Educators, Ethics Centre.

South Africa, Department of Basic Education (2011). Curriculum and assessment policy statement (CAPS): Physical sciences. Pretoria: Government Printers. Available:http://schools.pearson.co.za/media/73588/physical-sciences-caps-fet-jan-2011.pdf (Accessed: 12 May 2020).

South Africa, Department of Basic Education. 2011. *National Curriculum Statement (NCS): Curriculum and Assessment Policy Statement. FET Grades 10-12 - Physical Sciences.* Pretoria: Government Printing Works.

South Africa, Department of Basic Education. 2011a. *Curriculum and Assessment Policy: First Additional language for Grade 1-3, Foundation Phase*. Pretoria: Government Printer.

South Africa, Department of Basic Education. 2011b. *Province of the Eastern Cape Education. Handwriting guideline Grade R-3.* Pretoria: Government Printer.

South Africa, Department of Basic Education. 2015. *Action plan 2019*: *towards the realisation of schooling 2030: taking forward South Africa's National Development Plan 2030*. Pretoria: Government Printer.

South Africa, Department of Basic Education. 2018. *South Africa Rural Education Policy*. Pretoria: Department of Basic Education.

South Africa, Department of Education. 1996. Act No. 84, 1996: *South African Schools Act, 1996*. Government Gazette*,* 377(17579) 15 November. Pretoria: Department of Education.

South Africa, Department of Education. 2000. *Norms and standards for educators*. Pretoria: Government Printer.

South Africa, Department of Education. 2001a. *National Plan for Higher Education*. Pretoria: Government Printer.

South Africa, Department of Education. 2001b. *White Paper 6* on *Special Needs Education: building an inclusive education and training system*. Pretoria: Government Printer.

South Africa, Department of Education. 2002b. Integrated quality management system. Pretoria: Government Printer.

South Africa, Department of Education. 2003. *National Curriculum Statement Grades 10 -12 (General) History*. Pretoria: Government Printer.

South Africa, Department of Education. 2005. *Education for Rural People in Africa: Policy Lessons, Options and Priorities*. Pretoria: Department of Education.

South Africa, Department of Education. 2006. *The national policy framework for teacher education and development in South Africa*. Pretoria: Government Printer. Available: http://unesco.org/images/0014/001491/149112e.pdf. (Accessed: 20 August 2017).

South Africa, Department of Education. 2007. *The National Policy Framework for Teacher Education and Development in South Africa*. Pretoria: Department of Education.

South Africa, Department of Education. 2009. *Ministerial Committee on a National Education Evaluation and Development Unit. Final report 16 January 2009*. Government Gazette, No. 32133. Pretoria: Government Printer.

South Africa, Department of Higher Education and Training. 2010. Report of the Ministerial Committee on the review of the national student financial aid scheme. Pretoria: Department of Education. 51-52.

South Africa, Department of Higher Education and Training. 2010. *Integrated strategic planning framework for teacher education and development in South Africa: 2011–2025*. Pretoria: Department of Higher Education and Training.

South Africa, Ministerial Committee on Transformation and Social Cohesion and the Elimination of Discrimination in Public Higher Education Institutions. 2008. *Report of the ministerial committee on transformation and social cohesion and the elimination of discrimination in public higher education institutions*. Pretoria: Department of Education.

South Africa.info 2006. South Africa: Fast Facts. Available:http://www.southafrica.info/ess_info/sa_glance/facts.htm (Accessed: 10 May 2018).

Sooryamoorthy, R. 2013. *Scientific research in the natural sciences in South Africa: A scientometric study.* S Afr J Sci. 2013; 109(7/8). Available: http://dx.doi.org/10.1590/sajs.2013/20120001 (Accessed: 18 April 2020).

Spaull, N. 2013. Poverty and Privilege: Primary School Inequality in South Africa. *International Journal of Educational Development* 33: 436 - 447.Available: https://doi.org/10.1016/j.ijedudev.2012.09.009 (Accessed: 18 July 2020).

Statistics South Africa. 2016. *Statistical Release: General Household Survey, 2014*. Pretoria: Statistics South Africa.

Steyn, G. M. 2008. Continuing professional development for teachers in South Africa and social learning systems: conflicting conceptual frameworks of learning. *Koers* 73: 15-31.Available:http://www.scielo.org.za/scielo.php?script=sci_arttext&pid=S23048557 2008000100002&lng=en&tlng=en (Accessed: 17 April 2018).

Steyn, G. M. 2017. Transformative learning through teacher collaboration: a case study. *Koers*: *Bulletin for Christian Scholarship.* 82(1): 1-15. Available: https://hdl.handle.net/10520/EJC-73156d6c5. (Accessed: 18 March 2019).

Steyn, G. M. 2010. Educators' perceptions of continuing professional development for teachers in South Africa: *Qualitative study. Department of Further Teacher Education*. UNISA. Pretoria. South Africa

Steyn, T. 2010. Implementing continuing professional teacher development: policy and practice. *Acta Academica*, 42(4): 211-233. Available: https://hdl.handle.net/10520/EJC15511. (Accessed: 16 February 2018).

Stake, R.E. 2005. *Multiple case study analysis*. New York: Guilford press.

Stough, L. 2013. The place of classroom management and standards in teacher education. In *Handbook of classroom management* (pp. 919-934). Routledge.

Supovitz, J. A. and Turner, H. M. 2000. The effects of professional development on science teaching practices and classroom culture. *Journal of Research in Science Teaching: The Official Journal of the National Association for Research in Science Teaching*, 37(9): 963-980. Available: https://doi.org/10.1002/1098-2736(200011)37:9%3C963::AID-TEA6%3E3.0.CO;2-0 (Accessed: 1 August 2020).

Swain, M., Kinnear, P. and Steinman, L. 2015. Sociocultural theory in second language education. In *Sociocultural Theory in Second Language Education*. Multilingual Matters. Available: https://doi.org/10.21832/9781783093182 (Accessed: 18 May 2020).

Tanczer, L.M. 2015. Literature review: learning development service. Available: www.qub.ac.uk. (Accessed: 9 November 2020).

Taylor, F. 2013. *Self and identity in adolescent foreign language learning* (Vol. 70). Multilingual Matters.

Taylor, K. 2013. Simulations inside and outside the IR classroom: A comparative analysis. *International Studies Perspectives*, *14*(2): 134-149. Available: https://doi.org/10.1111/j.1528-3585.2012.00477.x (Accessed: 18 May 2020).

Terry, G., Hayfield, N., Clarke, V. and Braun, V. 2017. Thematic analysis. In Willig, C. and Rogers, W. eds. *The SAGE handbook of qualitative research in psychology.* 2nd ed. London: SAGE Publications, 17-37.

Thorne, S. 2000. Data analysis in qualitative research. *Evidence-Based Nursing*, 3(3): 68-70. Available: https://ebn.bmj.com/content/3/3/68 (Accessed: 12 August 2019).

TIMMS, TIMMS 2015 Grade 9 National Report. Available:http://www.timss-sa.org.za/download/TIMSS-2015-Grade-9-National-Report.pdf

Tracy, S. J. 2010. Qualitative quality: eight "big-tent" criteria for excellent qualitative research. *Qualitative Inquiry*, 16(10): 837-851.Available: https://doi.org/10.1177%2F1077800410383121(Accessed: 19 July 2018).

Topolinski, C. C. 2014. The influence of teacher leadership and professional learning on teachers' knowledge and change of instructional practices in low performing schools. (DEd, Paper 256. Western Michigan University)

Tsakeni, M. 2018. Inquiry-based practical work in physical sciences: Equitable access and social justice issues. *Issues in Educational Research*, 28(1), 187-201 Available: http://www.iier.org.au/iier28/tsakeni.pdf

Turuk, M.C. 2008. The relevance and implications of Vygotsky's sociocultural theory in the second language classroom. ARECLS, 5:244–262.Available: https://d1wqtxts1xzle7.cloudfront.net/37336864/vy gotsky.pdf? (Accessed: 13 March 2020).

Tuzlukova, V. 2018. "Exploring teachers' perceptions of 21st century skills in teaching and learning in English language classrooms in Oman's higher education institutions".

The Journal of Teaching English for Specific and Academic Purposes. 6(1):191-203. Available: https://doi:/10.22190/JTESAP1801191T (Accessed 15: April 2020).

United Nations Educational, Scientific and Cultural Organization (UNESCO). 2020. *UNESCO roadmap for implementing the global action programme on education for sustainable development 2030 Agenda*. Paris: UNESCO Publishing

Vail, T. M. 2011. Teachers' professional development experiences: implications for teaching practice. ProQuest LLC, Ed.D. Dissertation, University of the Pacific, United States.

Van der Westhuizen, P.C., Mosoge, M. J., Nieuwoudt, H.D. and Steyn, H.J. 2012. Perceptions of stakeholders on causes of poor performance in Grade 12 in a province in South Africa. *South African Journal of Education,* 22(2):113-118.

Van Deventer, K. J. 2009. Life orientation in the intermediate phase (grades 4-6): a survey in selected Western Cape primary schools, South Africa. *African Journal for Physical Health Education, Recreation and Dance*, *15*(3): 459-475.Available: https://hdl.handle.net/10520/EJC19586 (Accessed 8 June 2020).

Vhurumuku, E. 2010.The impact of explicit instruction on undergraduate students' understanding of the Nature of Science. *African Journal of Research in Mathematics, Science and Technology Education* 14(1):99-111. DOI: 10.1080/10288457.2010.10740676 (Accessed: 18 July 2020).

Villegas-Reimers, E. 2003. *Teacher professional development: an international review of the literature*. Paris: International Institute for Educational Planning.

Vivanco, L. and Delgado-Bolton, R. 2015. Professionalism. In: ten Have, H. eds. *Encyclopedia of Global Bioethics*. Cham: Springer, 1-10. Available: http://dx.doi.org/10.1007/978-3-319-05544-2_353-1 (Accessed: 13 October 2018).

Vollstedt, M. and Rezat, S. 2019. An introduction to grounded theory with a special focus on axial coding and the coding paradigm. *Compendium for Early Career Researchers in Mathematics Education*, 13: 81-100. Available: https://link.springer.com/content/pdf/10.1007/978-3-030-15636-74.pdf/10.1007%2F978-3-030-15636-74.pdf (Accessed: 19 May 2021).

Von der Heyden, S., Lukey, P., Celliers, L., Prochazka, K. and Lombard, A. T. 2016. Science to policy – reflections on the South African reality. *South African Journal of Science,* 112(11/12), Art. #0183. doi:10.17159/sajs.2016/a0183. (Accessed: 13 May 2020)

Vygotsky, L. S. 1978. Mind in Society. The Development of Higher Psychological Processes. Cambridge, MA: Harvard University Press

Wang, M.T. and Degol, J.L. 2017. Gender gap in science, technology, engineering, and mathematics (STEM): current knowledge, implications for practice, policy, and future directions. *Educational Psychology Review*, 29(1): 119-140.

Weiner, B. 1972. Attribution theory, achievement motivation, and the educational process. Rev. Educ. Res. 42, 203–215. Available: https://doi: 10.3102/00346543042002203 (Accessed: 10 March 2017).

Weiner, B. 1976. An attributional approach for educational psychology. Rev. Res. Educ. 4, 179–209. Available: https:// doi: 10.3102/0091732X004001179 (Accessed: 17 April 2018).

Weiner, B. 1979. A theory of motivation for some classroom experiences. New York: Springer-Verlag.

Weiner, B. 1985. An attribution theory of achievement motivation and emotion. Psychol. Rev. 92, 548–573. Available: https:// doi: 10.1037/0033-295X.92.4.548 (Accessed: 13 March 2017).

Weiner, B. 1986. An attributional theory of motivation and emotion. New York: Springer-Verlag.

Weiner, B. 2000. Intrapersonal and interpersonal theories of motivation from an attributional perspective. Educ. Psychol. Review 12: 1–14. Available: https:// doi: 10.1023/A: 1009017532121 (Accessed: 18 July 2018).

Weiner, B. 2001. "An attributional approach to perceived responsibility," in Responsibility: The Many Faces of a Social Phenomenon, eds A. E. Auhangen and H. W. Bierhoff (New York, NY: Routledge), 49–60.

Weiner, B. 2003.The classroom as a courtroom. Soc. Psychol. Educ. 6: 3–15.doi: 10.1023/A: 1021736217048 (Accessed: 18 July 2018).

Weiner, B. 2005. The development of an attribution-based theory of motivation: a history of ideas. Educ. Psychol. 45: 28–36. https:// doi: 10.1080/00461520903433596 (Accessed: 6 July 2017).

Weis, C. 2019. Situational ethics in a feminist ethnography on commercial surrogacy in Russia: negotiating access and authority when recruiting participants through institutional gatekeepers. *Methodological Innovations*, 12(1): 2059799119831853. Available: https://doi.org/10.1177%2F2059799119831853 (Accessed: 16 March 2020).

Wesonga, F. M. M. and Aurah, C. 2019. Influence of teachers' instructional strategies and students' learning styles on academic achievement in Kenyan high school Physics. *European Journal of Education Studies* .6(8):190-202.Available: https://doi:105281/zenodo.3550934

Wickham, N. 2013 "Teaching & Learning: some practical strategies from the classroom", *Lecture to Teacher Trainees, Manchester Metropolitan University.* Available:http://www.partnership.mmu.ac.uk/cme/Student_Writings/ETL/CraigB/CraigBootz.htm

Wiggins, S. 2017. *Discursive psychology: theory, method and application*s. Los Angeles: Sage.

Winter, L. K. and Butzon, J. 2009. Attribution theory and school reform. *JEP: E Journal of Education Policy*, *2*.

Wolhuter, C., Lemmer, E. and de Wet, N. 2007. *Comparative education: Education systems and contemporary issues*. Pretoria, South Africa: Van Schaik.

Wong, H. and Wong, R. 2015 "Classroom management is not discipline" Available: http://teachers.net/wong (Accessed: 18 March 2020).

Woolfolk, A. 2007. Educational psychology (10th ed.). New York: Pearson Education, Inc.

Wu, J. 2011. An investigation and analysis of attribution preference and gender difference of non-English majors' English learning-based on investigation of non-English majors in Tianjin Polytechnic University. *Journal of Language Teaching and Research* 2.2:332-337.

Yezbick, E. L. 2016. *The correlation between student/instructor rapport, student perceptions of instructor effectiveness, and course grade expectations* (Doctoral dissertation). Liberty University, Lynchburg, VA.

Yin, R. K. 2009. Case study research: design and methods. 4th ed. Thousand Oaks: SAGE Publications.

Yin, R. K. 2017. Case study research: design and methods. 5th ed. Thousand Oaks: SAGE Publications.

Yin, R.K. 2018. Case study research design and methods (5th ed). Thousand Oaks, CA: Sage Publication Inc.

Yusuf, M. A., Afolabi, F. O. and Oyetayo, M. O. 2014. Professionalization of teaching through functional teacher education in Nigeria. *European Scientific Journal*, 10(4): 107-118. Available: https://doi.org/10.19044/esj.2014.v10n4p%25p (Accessed: 17 February 2017).

Zenda, R. 2020. Impact of the Learner-Educator Ratio Policy on Learner Academic Achievement in Rural Secondary Schools: A South African Case Study, *Africa Education Review,* 17(3): 37-51. Available: https:// DOI: 10.1080/18146627.2019.1588748 (Accessed: 19 April 2021)

Zucker, H. 2021. Poliomyelitis: Infantile Paralysis. *African Journal of Medical Sciences*, 6(3): 1-12. Available: http://ajmsc.info/ (Accessed: 20 August 2021).

APPENDICES

APPENDIX ONE: DATA GENERATION INSTRUMENTS

Preliminary visit to schools

Introductions

1. To school heads and participants
2. Getting to know the participants' names, contact numbers
3. Explaining the purpose of my study and that their participation is voluntary, they can withdraw at any time they feel like without any harm. Giving them information letters and consent form for completing.

INTERVIEW SCHEDULES

Interview One Questions

1. Tell me about yourself, your teaching experiences and your school.
2. Tell me about the things that you enjoy in teaching Physical Sciences. Tell me about those things that you do not enjoy in teaching Physical sciences
3 Tell me about the learners that you teach Physical Sciences.
4. Talk to me about your teaching of Physical Sciences
5. Do you find that your teaching is different from others or the same, why do you think so?
6. Tell me what influences your preparation
7. Tell me what influences your choice of (a) classroom activities as a Physical Sciences teacher, (b) group work, (c) practical experiments, and (d) presentations. Tell me more about this.
8. Tell me what you think influences the way you teach.
9. Tell me what influences the way you ask questions.
10. Tell me how you carry out practical experiments in Physical Sciences?
11. Tell me how you handle answers given by learners after asking questions.
12. What influences the way you assist individual learners. The way you mark learners' work
13. Tell me what you think influences how you handle students who perform poorly?
14. How do you get to know the causes of their poor performance? How do you address these causes?
15. Tell me how you create a conducive learning environment in your classroom.
16. Tell me what influences the way you deal with learners who misbehave
17. Tell me how you deal with such learners
18. Do you accept blame for some of the challenges you encounter in your classroom? Explain
19. What are your views about the performance of learners in the NSC examinations for the past 5 years In Physical Sciences?
20. Is there anything you would like to add? Is there anything you like to ask me?

Interview Two questions

1 Tell me about a typical working day in your life as a Physical Sciences teacher from morning till you retire to bed at night discuss the things that you do that are related to your work.
2. Tell me about an exciting day in your school. What about in your classroom?
3. In what ways does the way you teach influence your growth as a teacher?
4. In what ways do the teaching strategies affect your growth as a teacher?
5. In what ways do your classroom activities influence your growth as a teacher?
6. In what ways does the way you choose classroom activities influence your growth as a Physical Sciences teacher?
7. What are your views about continuing to grow as a Physical Sciences teacher?
8. In what ways does the type of learners you teach influence your growth?
9. Tell me what you would need to help you to grow as a Physical Science teacher based in a rural/urban/ township Setting. In what ways would that help you?
10. What do you think should be done to help Physical Sciences teachers to grow professional?
11. What do you think should be done to help Physical Sciences teachers in their teaching?
12. Tell me, how you understand your professional growth in your life as a teacher in a secondary school.
13. Is there anything you would like to add? Is there anything you like to ask me?

DOCUMENT REVIEWS

The documents relevant for analysis in this study include the teacher's teaching documentation and departmental policies.

1. Annual teaching plans (ATP) (scheme of work)
2. CAPS document (policy document)
3. Students' work books
4. Record of marks
5. Any teaching/ learning material available (text books, study guides)

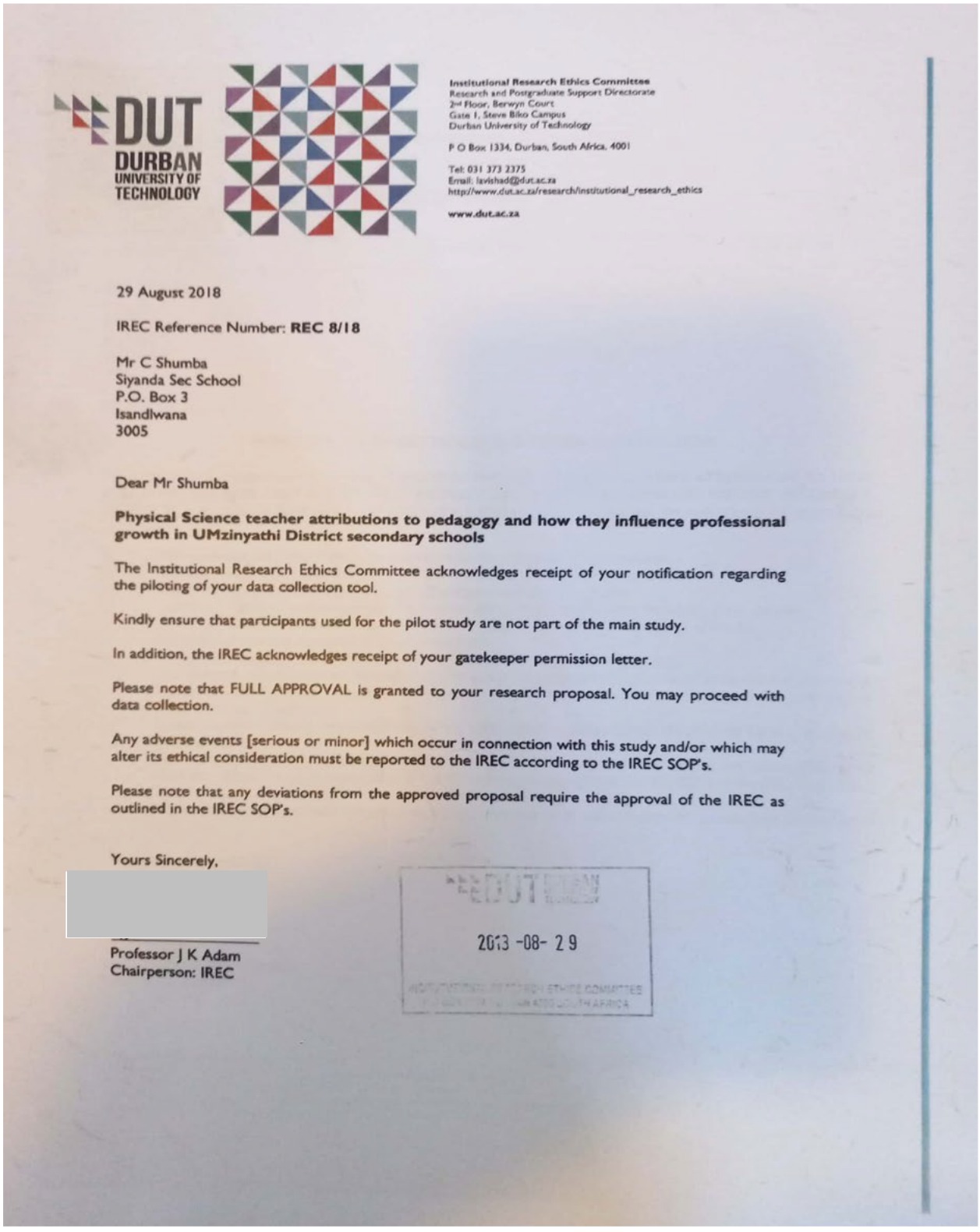
The focus of the document review analysis was on

1. teaching methods, - will check the types of teaching methods used (group work, discovery, lecture method any other)
2. learner activities- involves checking what learners do in class during the lesson eg writing notes, class work, practical work, presentations
3. lesson evaluation -observing teacher reflection on the lessons covered highlighting the successes and failures of the lesson
4. assessment- this involves checking the volume and quality of work
5. frequency of written work- involves checking both formal and informal assessment
6. marking style -involves checking the way marking is done, allocation of marks and the marks awarded or not awarded or universal ticks
7. comments on the learner's written work- checking comments (constructive, informative comments and corrections)

LESSON OBSERVATION GUIDE

1. The researcher will observe, and listen to the interactions in the lesson.
2. He will identify the strategies used by the teacher:
3. How does the teacher welcome and greet learners?
4. How does the teacher invite questions?
5. What kind of questions does the teacher ask?
6. How do learners respond?
7. How does the teacher respond to the learners' responses?
8. How does the teacher respond to wrong answers?
9. How do learners ask questions?
10. How does the teacher respond to learners' questions?
11. What language of teaching is used by the teacher?
12. What body language is displayed by (a) the teacher? (b) Learners?
13. Do learners show signs of interest/disinterest in the lesson?
14. How does the teacher handle the lack of interest?
15. Are there any signs of misbehaviour from the learners?
16. How does the teacher handle misbehaviour?
17. What resources/sources does the teacher use?
18. Does the teacher show enthusiasm in the subject?
19. What is the learning environment like?
20. How is the lesson concluded?

APPENDIX TWO: DUT ETHICAL CLEARANCE



DUT
DURBAN UNIVERSITY OF TECHNOLOGY

Institutional Research Ethics Committee
Research and Postgraduate Support Directorate
2nd Floor, Berwyn Court
Gate 1, Steve Biko Campus
Durban University of Technology

P O Box 1334, Durban, South Africa, 4001

Tel: 031 373 2375
Email: lavishad@dut.ac.za
http://www.dut.ac.za/research/institutional_research_ethics

www.dut.ac.za

29 August 2018

IREC Reference Number: **REC 8/18**

Mr C Shumba
Siyanda Sec School
P.O. Box 3
Isandlwana
3005

Dear Mr Shumba

Physical Science teacher attributions to pedagogy and how they influence professional growth in UMzinyathi District secondary schools

The Institutional Research Ethics Committee acknowledges receipt of your notification regarding the piloting of your data collection tool.

Kindly ensure that participants used for the pilot study are not part of the main study.

In addition, the IREC acknowledges receipt of your gatekeeper permission letter.

Please note that FULL APPROVAL is granted to your research proposal. You may proceed with data collection.

Any adverse events [serious or minor] which occur in connection with this study and/or which may alter its ethical consideration must be reported to the IREC according to the IREC SOP's.

Please note that any deviations from the approved proposal require the approval of the IREC as outlined in the IREC SOP's.

Yours Sincerely,

Professor J K Adam
Chairperson: IREC

2013 -08- 29

APPENDIX THREE: GATE KEEPER CLEARANCE - KZN DBE

education

Department:
Education
PROVINCE OF KWAZULU-NATAL

Enquiries: Phindile Duma | Tel: 033 392 1063 | Ref.:2/4/8/1453

Mr C. Shumba

Siyanda Secondary School
P. O Box 3
Isandlwana
3005

Dear Mr Shumba

PERMISSION TO CONDUCT RESEARCH IN THE KZN DoE INSTITUTIONS

Your application to conduct research entitled: **"EXPLORING PHYSICAL SCIENCE TEACHER'S ATTRIBUTIONS TO THEIR PEDAGOGY AND HOW THEY AFFECT THEIR PROFESSIONAL GROWTH IN UMZINYATHI DISTRICT SECONDARY SCHOOLS"**, in the KwaZulu-Natal Department of Education Institutions has been approved. The conditions of the approval are as follows:

1. The researcher will make all the arrangements concerning the research and interviews.
2. The researcher must ensure that Educator and learning programmes are not interrupted.
3. Interviews are not conducted during the time of writing examinations in schools.
4. Learners, Educators, Schools and Institutions are not identifiable in any way from the results of the research.
5. A copy of this letter is submitted to District Managers, Principals and Heads of Institutions where the Intended research and interviews are to be conducted.
6. The period of investigation is limited to the period from 26 January 2018 to 09 July 2020.
7. Your research and interviews will be limited to the schools you have proposed and approved by the Head of Department. Please note that Principals, Educators, Departmental Officials and Learners are under no obligation to participate or assist you in your investigation.
8. Should you wish to extend the period of your survey at the school(s), please contact Miss Phindile Duma at the contact numbers below.
9. Upon completion of the research, a brief summary of the findings, recommendations or a full report/dissertation/thesis must be submitted to the research office of the Department. Please address it to The Office of the HOD, Private Bag X9137, Pietermaritzburg, 3200.
10. Please note that your research and interviews will be limited to schools and institutions in KwaZulu-Natal Department of Education.

(See Attached List)

Dr. EV Nzama
Head of Department: Education
Date: 14 February 2018

APPENDIX FOUR: GATE KEEPER CLEARANCE LETTER TO HOD KZN DBE

The Head of Department

KwaZulu-Natal Department of Basic Education

P. Bag X9136

Pietermaritzburg

…….

Dear Sir/ Madam

RE: REQUEST FOR PERMISSION AND CONSENT TO CONDUCT EDUCATIONAL RESEARCH IN YOUR SECONDARY SCHOOLS.

My name is Christopher Shumba, a student at Durban University of Technology and currently pursuing a PhD - Teacher Development Studies. I humbly request permission to conduct an educational study in your schools in UMzinyathi district in KwaZulu-Natal Province. The topic of my study is: Physical sciences teacher attributions to pedagogical practice and how they influence professional growth in UMzinyathi district secondary schools.

Further information regarding this study please contact me (0789299093 or email address: chrisshumba@classicmail.co.za) for clarity or additional comments during the study and at any time after the study is complete or my supervisor: Prof T. G. Mukeredzi, PhD and Dr M. Thamae, PhD.

Researcher: Christopher Shumba

Adult, Community and Post-Graduate Education Unit

Durban University of Technology Indumiso/Midlands Campus

15 JF Sithole Road, Imbali 3201

Pietermaritzburg

KwaZulu-Natal, South Africa

Cell 0826056401/ 0762995974

Thank you for your time and consideration in this matter.

Yours sincerely,

Christopher Shumba (Cell: 0789299093)

APPENDIX FIVE: GATE KEEPER CLEARANCE LETTER TO UMZINYATHI DISTRICT: KZN

The District Manager

UMzinyathi District DBE

40 Wilson Street

Private Bag X2001

Dundee

3000

Dear Sir/ Madam

RE: REQUEST FOR PERMISSION AND CONSENT TO CONDUCT EDUCATIONAL RESEARCH IN YOUR SECONDARY SCHOOLS

My name is Christopher Shumba, a student at Durban University of Technology and currently pursuing a PhD - Teacher Development Studies. I humbly request permission to conduct an educational study in your schools in UMzinyathi district in KwaZulu-Natal Province. The topic of my study is: Physical sciences teacher attributions to pedagogical practice and how they influence professional growth in UMzinyathi district secondary schools.

Further information regarding this study please contact me (0789299093 or email address: chrisshumba@classicmail.co.za) for clarity or additional comments during the study and at any time after the study is complete or my supervisors: Prof T. G. Mukeredzi, PhD and Dr M. Thamae, PhD.

Researcher: Christopher Shumba

Adult, Community and Post-Graduate Education Unit

Durban University of Technology Indumiso/Midlands Campus

15 JF Sithole Road, Imbali 3201

Pietermaritzburg

KwaZulu-Natal, South Africa

Cell 0826056401/ 0762995974

Thank you for your time and consideration in this matter.

Yours sincerely,

Yours sincerely,

Christopher Shumba (Cell: 0789299093)

APPENDIX SIX: GATE KEEPER CLEARANCE LETTER TO SCHOOL PRINCIPALS

The Principal

……..

Dear Sir / Madam

REQUEST FOR PERMISSION AND CONSENT TO RESEARCH ON TEACHERS IN YOUR SCHOOL

My name is Christopher Shumba, a student at Durban University of Technology and currently pursuing a PhD in Teacher Education-Teacher Development Studies. I humbly request permission to conduct an educational study at your school. The topic of my study is: Physical sciences teacher attributions to pedagogical practice and how they influence professional growth in UMzinyathi district secondary schools.

I have provided you with a copy of my proposal which includes copies of the data collection tools and consent and/ or assent forms to be used in the research process, as well as a copy of the approval letter which I received from the Institutional Research Ethics Committee (IREC). You may contact me (0789299093 or email address: chrisshumba@classicmail.co.za) for clarity or additional comments during participation and at any time, even after the study is complete or my supervisors: Prof T. G. Mukeredzi, PhD and Dr. M. Thamae, PhD.

Researcher: Christopher Shumba

Adult, Community and Post-Graduate Education Unit

Durban University of Technology Indumiso/Midlands Campus

15 JF Sithole Road, Imbali 3201,

Pietermaritzburg, KwaZulu-Natal, South Africa

Cell: 0826056401/ 0762995974

Thank you for your time and consideration in this matter.

Yours sincerely,

Christopher Shumba (Cell: 0789299093)

To be completed by The School Principal

I……. hereby confirm that I understand the contents of this document and nature of the research, and I give authority and consent for teachers to participate in this research. I understand that participation is voluntary and they are at liberty to withdraw from the study at any stage, should they desire.

_____ _____

Signature of School principal School Stamp & Date

APPENDIX SEVEN: LETTER OF INFORMATION

Letter of Information for the participants

Title of the research study: Physical sciences teacher attributions to pedagogical practice and how they influence professional growth in UMzinyathi district secondary schools.

Principal researcher: Christopher Shumba

Supervisors: Prof. Tabitha Mukeredzi: PhD; Dr Mamothibe Thamae: PhD

Brief introduction and purpose of the study:

The purpose of the study is to understand Physical Sciences teacher attributions to their pedagogical practices in secondary schools and how that influences their professional growth. The study hopes to come up with recommendations to The Department of Basic Education (DBE) for relevant on-going Physical Sciences teacher professional development programmes.

You have been chosen because you are a qualified Physical Sciences teacher in a secondary school, and you are teaching in a township school/ urban school/ rural school in UMzinyathi district.

Outline of the procedure

Your participation will take the form of two face-to-face interviews which will take place on alternate months and they will last between 45 minutes to one hour. I will also request to look at the teaching documents before we commence interviews and before the last interview. I will also request to observe your lessons. All these processes will be done at your school. Your participation is voluntary and if you decide to take part you will still be free to withdraw at any time without giving a reason. Withdrawal from participating in the study will not have any negative consequences for anyone deciding to do so. I will audio record the discussions with your permission and will also write down some notes. The interviews will follow document reviews on the same day and lesson observations will be done on separate days before the last interview. The study will take place between March 2018 and June 2018.

Follow up interviews may be carried out in order to verify information provided during interviews

Risks or discomforts to the participants

You will not experience any risks or discomforts since interviews will be audio recorded only when permission is granted by you.

Benefits (to the participant and the researcher)

This study will provide a platform for you as Physical Sciences teachers to be heard with regards to your attributions related to pedagogies and how they influence your professional growth. The Department of Basic Education may use this information to come up with relevant training programmes for teacher professional development which may benefit all Physical Science teachers and other stakeholders in the teaching profession. The findings of this research will be made available to the DBE and to yourself should you wish to read them.

As a researcher I will use the information generated from this study to publish articles for the benefit of all stakeholders concerned.

Reasons why participants may be withdrawn from the study

You may choose to withdraw from the study at any time without any harm.

Remuneration

Since the interviews may last for an hour, I will provide you with refreshments each time we meet.

Costs of the study

You are not expected to cover any costs towards the study.

Confidentiality

All data will be kept with the highest degree of confidentiality. I will not include your name or the name of your school. This will be done so that nobody can recognise you from the information that you will provide. I will use pseudo names when presenting the findings and information will be kept confidentially. All interviews will be done at your school in your office/ storeroom/ laboratory or any private room. I will make sure that information generated will be solely for the research.

Research-related injury

There will be no research related injury to yourself as a result of the study.

Persons to contact in the event of any problems or queries

Supervisor: Prof Tabitha Mukeredzi, PhD

TabithaM@dut.ac.za Cell: 0826056401/ 0762995974

Dr. M. Thamae, PhD

mamothibet@dut.ac.za Cell: 0837462049

The persons to contact in the event of any problems or queries- Research ethics administrator on **031 373 2375**. Complaints can be reported to: Acting Director: Research and Postgraduate Support Prof C E Napier: Contact number **031 373 2577**.

APPENDIX EIGHT: LETTER TO PARTICIPANT

Dear Participant,

My name is Christopher Shumba, a student at Durban University of Technology and currently pursuing PhD in Teacher Education - Teacher Development Studies. I humbly request you to participate in my study entitled: **Physical sciences teacher attributions to pedagogical practice and how they influence professional growth in UMzinyathi district secondary schools.**

The purpose of the study is to understand Physical Sciences teacher attributions to their pedagogical practices in secondary schools and how that influences their professional growth.

I have attached an **Information Letter** which explains all the research procedures. You may contact me (0789299093 or email address: chrisshumba@classicmail.co.za) for clarity or additional comments during the study and at any time after the study is complete or my supervisors: Prof. T. G. Mukeredzi, PhD and Dr M. Thamae, PhD.

Researcher: Christopher Shumba

Adult, Community and Post-Graduate Education Unit

Durban University of Technology Indumiso/Midlands Campus

15 JF Sithole Road, Imbali 3201,

Pietermaritzburg, KwaZulu-Natal, South Africa

Cell: 0826056401/ 0762995974

Thank you for your time and consideration in this matter.

Yours sincerely,

Christopher Shumba (Cell: 0789299093)

To be completed by participants

I……. hereby confirm that I understand the contents of this document and nature of the research, and I give my authority and consent to participate in this research. I understand that participation is voluntary and I am at liberty to withdraw from the study at any stage, should I desire.

_____ _____

Signature of participant Date

APPENDIX NINE: CONSENT FORM

Statement of Agreement to participate in the Research study

•I hereby confirm that I have been informed by the researcher, about the nature, conduct, benefits and risks of this study-Research Ethics Clearance Number: REC 8/18

•I have also received, read and understood the above written information (Participant Letter of Information) regarding the study.

•I am aware that the results of the study, including personal details regarding my sex, age, date of birth, initials and diagnosis will be anonymously processed into a study report.

•In view of the requirements of research, I agree that the data collected during this study can be processed in a computerized system by the researcher.

•I may at any stage, without prejudice, withdraw my consent and participation in this study.

•I have had sufficient opportunity to ask questions (of my own free will) and declare myself prepared to participate in the study.

•I understand that significant new findings developed during the course of this research which may relate to my participation will be made available to me.

•I have agreed to have the interview tape recorded.

•I have agreed to the use of pseudonym.

…… ……./…./2018 ……. ……

Name of Participant Date Time Signature

I Christopher Shumba herewith confirm that the above participant has been fully informed about the nature, conduct and risks of the above study.

Christopher Shumba ….. / …. /2018

Full name of researcher Date Signature

…… ……/…./2018 …….

Full name of witness Date Signature

APPENDIX TEN: The nature of Physical Sciences teacher attributions to pedagogical Practices

KEY: With reference to Appendix Five, a tick (√) represents more than three comments which the teacher made during the interview on a specific theme/code. The tick (√) further represents that the teachers attributed their pedagogical practices to that aspect, while a blank indicates that they were silent about it. The silence implies that the participants did not attribute their pedagogical practices to the aspect.

Table 5.2: Number of time participants' comments suggested the nature of Physical Sciences teacher attributions to their pedagogy.

Participant (N=16)	Classroom Practice			Attributions Related to Resources	Attributions Related to Learner Factors		Attributions Related to Teacher Competence
	Lesson Preparation	Lesson Delivery	Classroom Management	Teaching & Learning Resources	Learner Family Background	Attitude towards the subject	Subject Content Knowledge
Teacher 1 Rural	√	√	√	√		√	√
Teacher 2 Rural	√	√	√	√	√	√	√
Teacher 3 Rural	√	√	√	√	√	√	√
Teacher 4 Rural	√	√	√	√	√	√	√
Teacher 5 Rural	√	√	√	√		√	√
Teacher 6 Rural	√	√	√	√	√		√
Teacher 7 Rural	√	√	√	√	√	√	√
Teacher 8 Rural	√	√	√	√	√	√	√
Teacher 1 Urban	√	√	√			√	√
Teacher 2 Urban	√	√	√			√	
Teacher 3 Urban	√	√	√				
Teacher 4 Urban	√	√	√				√
Teacher 1Township	√	√	√	√		√	√
Teacher 2Township	√	√	√	√	√		
Teacher 3Township	√	√	√			√	√
Teacher 4 Township	√	√	√	√	√		
Total number of teachers	**16**	**16**	**16**	**11**	**8**	**11**	**12**

Key: Codes (Teacher 1 to 8) were used for confidentiality.

APPENDIX ELEVEN: Influence of teacher attributions on professional growth

KEY: With reference to Appendix Six, a tick (√) represents at least two comments which the teacher made during the interview on a specific theme/code. The tick (√) further represents that the teachers showed professional growth through that aspect, while a blank indicates that they were silent about it. Blank spaces further indicate that the responses did not suggest professional growth).

Table 6.1: Number of time participants' comments suggested professional growth

Participants (N=16)	**Professional Growth Through Improvisation**		**Professional Growth Through Handling Learner Diversity**		**Professional Growth Through Networking**
	Improvisation in Laboratory Work	Innovation	Code Switching	Handling Progressed Learners	Networking with other Educators
Teacher 1 Rural	√	√	√	√	√
Teacher 2 Rural	√	√	√	√	√
Teacher 3 Rural	√	√	√	√	√
Teacher 4 Rural	√	√	√	√	√
Teacher 5 Rural	√	√	√	√	√
Teacher 6 Rural	√	√	√	√	√
Teacher 7 Rural	√	√	√	√	√
Teacher 8 Rural	√	√	√	√	√
Teacher 1 Urban			√	√	√
Teacher 2 Urban			√		√
Teacher 3 Urban	√	√	√	√	√
Teacher 4 Urban	√	√	√		√
Teacher 1Township	√	√	√	√	√
Teacher 2Township	√	√	√	√	√
Teacher 3Township	√		√	√	√
Teacher 4Township	√	√	√		√
Total number of teachers	**14**	**13**	**16**	**13**	**16**

Key: Codes (Teacher 1 to 8) were used to ensure confidentiality**.**