

# **EXPLORING SIGNATURE PEDAGOGIES IN RADIOGRAPHY EDUCATION AT A SOUTH AFRICAN UNIVERSITY**

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## DECLARATION

I, Zombuso Cynthia Dlodla, do hereby declare that this dissertation represents my own work and that as far as I know, no other similar dissertation exists. I have indicated and acknowledged all the sources used accordingly.

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Approved for final submission

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## ABSTRACT

The radiography profession is dynamic and is greatly influenced by advances in medical technology, and political, socio- economic factors. This raises questions about the ability of radiography teaching and learning strategies to equip students with the necessary skills for professional practice in the 21<sup>st</sup> century. This is an indication that there is a need to identify pedagogies as well as teaching and learning strategies that will ensure that the 21<sup>st</sup> century students are well inducted into the profession.

In 2005 Shulman introduced a theory of signature pedagogies, after observing how professions such as medicine and law inducted their students into their professions. Signature pedagogies are methods, or modes, of teaching that are indistinguishably identified with preparing students for a particular profession, turning novices into professionals who have the ability to think, perform and act with integrity. Innovative pedagogies are essential to ensure that future radiographers have the necessary skills to think critically, perform and act with professionalism and integrity according to the standards of the profession.

The purpose of the study was to identify teaching and learning strategies that are frequently employed by those involved in radiography education, both in academic and clinical education. It was also to explore and to identify the presence of any characteristics of signature pedagogies, and to determine the existence of signature pedagogies in the teaching and learning strategies employed by professionals involved in radiography education.

The findings of the study, obtained through interviews, classroom observations and document analysis, established that clinical education is the signature pedagogy in radiography education. Signature pedagogies by nature have embedded in them epistemological, ontological and axiological aspects. These were identified within clinical education. Although there are variations locally, nationally and internationally on how clinical education is structured, it was however observed that there are other characteristics of signature pedagogies such as pervasive, routine and involve active student engagement, which further satisfy Shulman's criterion of signature pedagogies. Elements of signature pedagogies were noted in the simulation and demonstration

pedagogies. These need further exploration due to the limited number of participants in this study.

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## LIST OF ACRONYMS

<b>CPSM</b>	Council of Profession Supplementary to Medicine
<b>CQPA</b>	Centre for Quality Promotion and Assurance
<b>DUT</b>	Durban University of Technology
<b>EBL</b>	Enquiry based learning
<b>HPC</b>	Health Professions Council
<b>HPCSA</b>	Health Professions Council of South Africa
<b>KH</b>	Know how
<b>KT</b>	Know that
<b>KZN</b>	Kwa Zulu-Natal
<b>MKO</b>	More knowledgeable others
<b>NQSF</b>	National Quality Standards Framework
<b>PBL</b>	Problem based learning
<b>PCK</b>	Pedagogical content knowledge
<b>SA</b>	South Africa
<b>SAQA</b>	South African Qualifications Authority
<b>SDR</b>	Supplementary diagnostic radiography
<b>SORSA</b>	Society of Radiographers of South Africa
<b>SP</b>	Signature pedagogy

<b>SOW</b>	Scheme of work
<b>UK</b>	United Kingdom
<b>UKZN</b>	University of Kwa Zulu-Natal
<b>UoT</b>	University of Technology
<b>WIL</b>	Work integrated learning
<b>WPL</b>	Work place learning
<b>ZAD</b>	Zone of actual development
<b>ZPD</b>	Zone of proximal development

## GLOSSARY

**Clinical skills:** In the context of this study clinical skills include communication skills, procedural knowledge, reasoning skills, professional knowledge, and patient care.

**Competencies:** Capabilities people need to have in order to live, learn and contribute as active members of their communities; these cannot be learned in isolation; rather, need to be demonstrated in the performance of tasks and are most effectively developed in contexts with embedded meaning and purpose.

**Industry:** A classification that refers to a group of companies that are related in terms of their primary business activities. In this study the term refers to radiology service providers.

**Innovative pedagogies:** Innovation generally refers to the creation of better or more effective products, processes, technologies, or ideas that are accepted by those in charge of education, i.e. teachers, administrators, parents.

**Instructor:** Someone who instructs. In the context of this study refers to tutor who mentors and teaches students during their education.

**Novice:** A person that is new to and inexperienced in a job or situation, in this case a student.

**Pedagogy:** The science/theory or art/practice of teaching that makes a difference in the intellectual and social development of students.

**Practical skills:** Relate to the application of knowledge, theory and/or skills students have developed in order to successfully complete assigned tasks.

**Professional ethics:** Defined as the personal and corporate rules that govern behaviour within the context of a particular profession.

**Professional knowledge:** In depth knowledge of concepts related to the profession, i.e. a synthesis of acquaintance, propositional and procedural knowledge.

Professionalism: The conduct, aims, or qualities that characterize or mark a profession or a professional person.

Signature: A distinctive pattern, product, or characteristic by which someone or something can be identified.

Technical skills: Efficient handling of medical equipment, application of radiation safety and equipment quality control tests.

Technique: Way of carrying out a particular task, especially the execution or performance of a scientific procedure.

Signature pedagogies: Characteristic modes of teaching and learning that are unique, distinctive and which educate and prepare graduates for a particular profession.

## CHAPTER ONE: INTRODUCTION TO THE STUDY

### 1.1 INTRODUCTION

The purpose of the study was to establish the teaching and learning strategies that are frequently employed by the lecturers in the radiography education programmes, and secondly to identify the presence of any characteristic teaching practices that are particular to radiography, namely any characteristics of signature pedagogies. Furthermore it was to establish the existence of signature pedagogies in the teaching and learning strategies employed by professionals involved in radiography education. Signature pedagogies (SPs), according to Shulman (2005), are methods or modes of teaching that are indistinguishably identified with preparing students for a particular profession. It is envisaged that the findings of the study will help in identifying effective SPs in radiography education which can be transferred across all disciplines of radiography education thus ensuring that graduates are well equipped to deliver appropriate care, which is aligned with the ever changing South Africa healthcare system. In addition the importance of SPs that they identify what is important in the discipline in terms of knowledge and practice.

### 1.2 BACKGROUND

The evolving South African higher education system provides an appropriate opportunity for the development pedagogies and application of teaching and learning strategies that are aimed at meeting the industry needs, and also equip the graduates with skills that will endure in the ever changing education and political landscape. Institutions of higher education have to constantly evaluate their practices to keep abreast with the dynamic climate.

Radiography education is affected by changes in higher education as well as by changes and demands in the healthcare system. These changes bring new challenges, such as advances in medical technology, globalisation, social, political and economic factors, and changes in the scope of practice for radiographers which introduce new and additional responsibilities (Decker, 2009; Engel-Hills, 2005; Gqweta, 2012)

In addition the 21st century high technology challenges have an impact in the teaching and learning approaches, since what worked in the past is not adequate to meet the new demands. These challenges raised questions about the ability of radiography teaching and learning strategies to equip students with the necessary skills for professional practice (Youatt & Wilcox, 2008).

Radiography, as a profession, has evolved in the past few decades. However, some technical procedures and protocols have remained essentially the same. For example, the technique on how to perform a standard chest radiograph is unchanged. On the other hand, there have been major changes in medical equipment technology, which have impacted image development and interpretation, safe practices, and ethical guidelines, for example. In the early years, radiographs (X-rays) were developed manually in tanks in a darkroom and had to be hung by pegs to dry. With progress, automatic processors were developed which resulted in radiographs being developed in ten minutes and eventually ninety seconds. Ninety second processors are still in operation, but images are now mostly digitally produced. This has implications in the preparation of students for the profession, balancing the old and the new technologies.

Radiography education in South Africa, and universally, has always from inception acknowledged the value of integrating theory and practical clinical skills (Engel-Hills, 2005). In the early years when radiography training and education was introduced in South Africa it was hospital based. This applied to training from 1945-1985 in KwaZulu-Natal. Hospital based training meant it was easier to align theory with practice. Students spent part of the day in the classroom and the rest of the day involved with practical skills development in the clinical sites. The lecturers were visible and could easily move from the classroom to the clinical sites to oversee and monitor students. Teaching and learning took place in context. Radiographers who were also involved in the teaching of students were kept abreast of changes in technical theoretical content and new developments in practical skills.

The majority of Durban University Technology (DUT) academic staff, including the researcher, in the radiography department are radiographers who underwent hospital based education. It has to be noted that one criticism of hospital based education was

the emphasis on practical skills, as students spent more time in the clinical environment rather than in the classroom. Radiography, as a profession, is skills based so practical apprenticeship skills are necessary, but cognitive skills are just as important. At that time it was felt that the education was preparing future radiographers to be technicians rather than professionals as stated by Baird (2008).

A former lecturer in radiography mentioned in a telephonic conversation on 22 April 2013 that when radiography education in KwaZulu-Natal (KZN) moved to Technikon Natal (now DUT) in 1985, the traditional practice of integration was maintained. However, the growing student numbers resulted in more clinical centres being introduced and it became challenging for the lecturers to be visible in all of these additional centres. Clinical coordinators, who were responsible for the students' clinical education, were introduced. With the education now based in the universities, gaps were identified and are still in existence in the students' ability to transfer technical theory knowledge into the clinical workplace or practice (Baird, 2008; Cockbain, Blyth, Bovill, & Morss, 2009). The gaps are an on-going area of concern. Such gaps are always discussed at academic and industry committee meetings or advisory board meetings in KZN. Some issues involve students' lack of skills such as critical thinking, professionalism, patient care, and soft skills such as values, ethics and integrity.

Various studies have been conducted, nationally and internationally, exploring innovative teaching and learning approaches that can enhance students' critical thinking skills, reflective skills and how to integrate these with practical skills. In 2005 Engel-Hills's doctoral thesis explored the benefits of an integrated learning curriculum. Cockbain et al. (2009) advocated the blended learning approach. Hamilton and Druva (2010) identified the need to promote critical reflection in undergraduate radiography courses. Baird (2008) explained the importance of including critical reflection skills in the radiography curriculum. Kowalczyk, Hackworth, and Case-Smith (2012) explored the confidence levels among those involved in radiography education in teaching and assessing critical thinking skills. The findings of their study indicated that those with the highest academic qualifications were very confident and competent in embracing teaching strategies that promote and enhance critical thinking skills.

These studies are an indication that there is a great need to identify pedagogies and teaching and learning strategies that will ensure that students are well inducted into the profession. According to Shulman (2005) the full application of signature pedagogies (SPs) can enhance the education and the profession. Signature pedagogies are unique to a particular profession and transform generic teaching and learning strategies into discipline specific ones (Shulman, 2005). He further stated that these teaching and learning strategies can turn novices into professionals who have the ability to think, perform and act with integrity. Innovative pedagogies can aid in ensuring that future radiographers have the necessary skills to think critically, perform and act with professionalism and integrity according to the standards of the profession (Wayne, Raskin, & Bogo, 2010; Youatt & Wilcox, 2008). The radiography profession is characterised by distinct and unique core values and specific graduate attributes. In order for graduates to meet the requirements of the profession, they have to demonstrate an appropriate level of technical skills that is necessary when handling medical equipment (Williams & Berry, 1999). Furthermore, as stated by these authors, graduates have to demonstrate appropriate cognitive and technical skills of protocols, principles and procedure in radiography according to the set professional standards. They have to demonstrate image interpretations knowledge and skills and also practice within the set code of conduct in line, with radiation safety to the patients, other healthcare workers and members of the public (Williams & Berry 1999).

### 1.3 SIGNIFICANCE OF THE STUDY

Literature indicates that there is a need to reform current pedagogies and teaching and learning strategies in order to balance the gap between old and new practices, improve the integration and transference of theory to practice, promote critical reflection and implementation of innovative pedagogies thus enhancing students' learning experience.

Identifying teaching and learning strategies that are employed in radiography education could aid in establishing ways of improving current practices and the broader application of improved teaching and learning strategies innovative pedagogies. The goal is to positively impact on students' learning and radiography education.

Signature pedagogies have deep, surface and explicit dimensions. These are structured for the purpose of developing and enhancing a particular profession (Shulman, 2005). In radiography education these may be consciously or unconsciously employed by those involved in education. However, by identifying the elements of SPs and making them explicit, could aid in strengthening and improving their practices and the developing of both technical and soft skills. As indicated by Watkins (2014) SPs have by their own nature epistemological, ontological and axiological aspects. They cover the knowledge that professionals need in a variety of situations, capture how they make practical meaning of their actions whilst maintaining the core values that guide their actions. Hence the application of SPs in education could improve the challenge of integrating theory to practice. By applying knowledge in a variety of situations the students' critical thinking and problem solving skills may improve. SPs are dynamic and may incorporate innovative teaching strategies that address challenges of the 21<sup>st</sup> century students who are easily distracted by technology.

The results of the study could open other research opportunities with researchers evaluating the effectiveness of the identified signature pedagogies which is not part of this study. The results of the study could open other research opportunities nationally, since there seems to be no known published articles on signature pedagogies for the radiography profession. Although extensive research has been conducted in other fields it essential to conduct studies that are discipline specific since variations among particular disciplines tend to be present when observed at a deeper level. The findings of the study may contribute in curriculum developments, provide direction for future research, and contribute to the existing body of knowledge.

The research questions that this study seeks to answer are:

1. What are the current teaching and learning strategies used most frequently by the lecturers in the radiography programmes?
2. What strategies can be identified as signature pedagogies for radiography?

#### 1.4 STRUCTURE OF THE THESIS

This report is structured in the following format. Chapter One provides the background and the significance of the study. In Chapter Two the literature is discussed including the theoretical and conceptual framework. Chapter Three outlines the research design, describes the research methodology, data collection methods and data analysis. Also included in Chapter Three is the discussion on study ethics and ethical clearance. The research findings are discussed in Chapter Four. Chapter Five concludes the findings and provides implications and limitations of the study.

The next chapter is the discussion on literature related to the study including the theoretical and conceptual framework.

## CHAPTER TWO: LITERATURE REVIEW

### 2.1 INTRODUCTION

Literature on teaching and learning strategies in radiography education, forms of knowledge, ways of knowing in radiography and the exploration of signature pedagogies (SPs), as the theoretical framework that underpins the study, both internationally and in South Africa, are covered in this chapter. The initial focus of the discussion is on an historical overview of radiography education locally, nationally and internationally. The emphasis is however on the United Kingdom (UK) since early radiography education in South Africa was based on the British model. Forms of knowledge, and ways of knowing and their relation to the profession of radiography and its education within the South African context, are discussed next. SPs as the theoretical and conceptual framework of the study are discussed with an emphasis on how they can impact on the education and preparation of students for specific professions including radiography.

The profession of radiography globally has always been influenced by social, political, economic and technological factors (Decker, 2009). Moreover these factors impact greatly on both the clinical practice and the educational components of the profession both internationally as well as here in South Africa. The profession is dynamic and is greatly influenced by advances in technology. Thus to understand the current and future trends it is important to review the profession's history and how it helped to shape both the profession and its education (Bentley, 2005).

### 2.2 HISTORICAL OVERVIEW

The history of radiography education that is discussed here pertains to the UK and South Africa (SA), since the first SA qualified radiographer who pioneered education for radiographers was educated and trained in UK. As a result, the UK and SA shared a similar curriculum until 1963 (Engel-Hills, 2005; Peer, 2012)

### 2.2.1 United Kingdom

Although X-rays were discovered in 1895 by Wilhelm Roentgen, it was in 1910 when the first formal radiography training was introduced in UK; it was hospital based and purely practical with no theory (Bentley, 2005; Decker, 2009; Price, 2001; Reeves, 2009). This was followed in 1917 by hospital certified qualifications that covered both theory and practical skills as mentioned by Bentley (2005). According to him the first formal examinations were conducted by the Society of Radiographers (UK) in 1922, in order for the radiographers to register with a professional body. Furthermore a ruling was made in the early 1930s stipulating that for radiographers to meet professional standards, they had to perform independently a minimum number of 500 X-rays. Another milestone was achieved in 1945 as it was specified that for radiographers to meet the qualification requirements they had to produce evidence of two years formal training (Bentley, 2005). This meant formal training steadily increased from six months to twenty-four months and it is how the diploma qualifications were introduced in the profession.

Radiography struggled to be regarded as a profession until 1961, which saw the first registration of radiographers into the Council of Professions Supplementary to Medicine (CPSM); this was eventually replaced by the current Health Professions Council (HPC) (Decker & Iphofen, 2005). The emphasis on practical skills was viewed as the drawback for recognising radiography as a profession (Decker, 2009). Pressure to improve the status of the profession, and to achieve a balance between theory and practical, saw the move from hospital based education to institutions of higher education in the late 1980s to early 1990s (Decker & Iphofen, 2005). The result of the move was the progression from six months skills training to the introduction of diplomas, which was followed by the implementation of professional degrees in 1993 (Bentley, 2005).

### 2.2.2 South Africa

This chapter on the history of radiography in South Africa focusses on Kwa Zulu-Natal. Other provinces are also briefly mentioned. The South African political history influenced the development of the local radiography profession. Early X-ray examinations were performed by an amateur photographer and a medical doctor following Roentgen's discovery (Bensusan, 1967). The first qualified radiographer was

UK trained. She pioneered radiography education in SA in 1933 with an intake of four students that increased to 46 students by 1938 (Engel-Hills, 2005). The training was hospital based and skills focused as minimal theory lectures were conducted at night (Engel-Hills, 2005). As the demand for radiographers grew schools of radiography were introduced in various South African provinces at different time intervals. Radiography training was only offered to white students as stated by a former head of the School of Radiography, King Edward VII Hospital in Durban, in her email correspondence received on 10 May 2015. Training of white students was offered at the School of Radiography, Addington Hospital in Durban. The first intake of other races in Kwa Zulu-Natal was in 1961 when the School of Radiography was opened at King Edward VIII Hospital. This remained unchanged until student education and training moved to Technikon Natal (now DUT) in 1985. At the said academic institution the students shared the same facilities regardless of race, however clinical placements were still race segregated assigned, until post 1994, as per telephonic conversation with a former lecturer on 22 April, 2013. This was in line with the South Africa apartheid era but such segregation ceased prior to 1994. The education, as stated before, followed the British model and the Society of Radiographers (UK) was the initial examining body. In 1963 training was taken over by the South African Department of National Education (Engel-Hills, 2005; Peer, 2012). In 1987 radiography education and examinations became the responsibility of the institutions of higher education (technikons) which became universities of technology after 1994. The main focus of early education was diagnostic radiography which was followed by radiotherapy, then nuclear medicine and finally ultrasound. The two year national diploma in diagnostic radiography was the initial programme. It developed into a three year diploma or degree in 1978. Radiotherapy and nuclear medicine were introduced as three year diploma qualifications in some training centers in South Africa. In KZN these qualifications were offered as a second qualification to diagnostic radiographers. Ultrasound was offered in KZN as a certificate course for diagnostic radiographers.

With the demand for radiographers, especially in rural black hospitals, the supplementary diagnostic radiography (SDR) programme, a yearlong qualification was offered to black students at Baragwaneth, and Kalafong Hospitals, respectively in the 1970s and 1980s, and in KZN at Edendale Hospital from 1982 until 1991. There was no formal articulation for the supplementary radiographers; they were all required to start formal education from the first year of the national diploma with no recognition of prior knowledge. In 1998 Technikon Natal (now DUT) offered the articulation opportunity for supplementary radiographers to enroll in the three-year national diploma radiography diagnostic qualification at second year.

For a number of years the only form of articulation in the profession was a higher diploma. The first degree offered in KZN was the bachelor of technology which was introduced in 1996 replacing the higher diploma. The introduction of professional degrees in South Africa has been very slow as compared to 1993 in the UK. In KZN the professional degrees were implemented in 2016, whereas in other provinces they have been in place since 2014. A point to note is that some traditional South African universities, such as the University of Pretoria, and Medical University of South Africa, involved in radiography education have always offered degrees. For insight into radiography education it is essential to broadly discuss knowledge, various forms of knowledge, and ways of knowing as relevant to radiography before elaborating on teaching strategies.

## 2.3 KNOWLEDGE

There are numerous types of knowledge and the way knowledge is understood reflects differently in different research paradigms. The social constructivists maintain that knowledge is socially constructed and people gain knowledge through social interaction with each other (Andrews, 2012; Applefield, Huber, & Moallem 2001; Berger & Luckmann, 1991). The researcher has drawn on the work by de Jong and Ferguson-Hessler (1996), in the classification of knowledge into situational, conceptual, procedural and strategic. Other authors have used the combination of the 'know what' and the 'know how' when defining knowledge (Muller, 2009; Winch, 2013). The 'know what' is described as the structure or forms of knowledge; the 'know how' describes the

ways of knowing. This section of literature discussion covers knowledge in terms of forms of knowledge and the ways of knowing within higher institutions of teaching and learning and radiography professional education.

### 2.3.1 Forms of knowledge

The importance of knowledge in radiography can be explained by the fact that the profession is a combination of art and science (Day & Sodickson, 2011). The artistic and scientific aspects are demonstrated in the acquisition of images using scientific knowledge in turning straight lines into diagnostic images (Day & Sodickson, 2011). Moreover forms and types of knowledge inform the development of the curriculum. Radiography curriculum is based on the type of knowledge that can be classified under the traditional and fourth generation qualifications because this classification involves application of knowledge in practical situations (Muller, 2009).

The forms of knowledge that are discussed in this section are: acquaintance, propositional and procedural knowledge; Bernstein's (1999) horizontal and vertical discourses; content knowledge, curriculum knowledge; and Shulman's (1987) pedagogical content knowledge. These forms of knowledge have a bearing on the study's focus on teaching and learning strategies and how one structures the curriculum and the pedagogical approaches that could be engaged. Several forms of knowledge have been described and discussed by various authors depending on the particular author's position (sociology or philosophy) and how and where the knowledge was obtained. Philosophers have categorised knowledge into three groups: acquaintance (personal), propositional (know that (KT)) and procedural (practical or know how (KH)) knowledge (Muller, 2009; Winch, 2013).

According to Winch (2013) the acquaintance knowledge is the knowledge that a person possesses through experience of which the qualities and characteristics of the known knowledge is embedded and thus cannot be understood in any other way. He further emphasised that without the acquaintance knowledge, students may not fully understand the important qualities of the subject content. In addition he stated that elements of propositional knowledge are needed within the acquaintance knowledge. Acquaintance knowledge forms a significant foundation in radiography education,

especially when teaching professional morals, values and ethics, which are important when students deal with patients and community members during their clinical education (Fortsch, 2007). The acquaintance knowledge that students bring into the learning environment significantly contributes to their interactions within and outside their academic environment as effective patient care forms a major clinical competence in the profession (Fortsch, 2007). Acquaintance knowledge can further be developed through academic and clinical education approaches aimed at promoting effective patient care, professional values and morals which are aligned with Shulman's (2005) habits of the heart.

Propositional knowledge (knowledge that: KT) refers to the knowledge of concepts and facts (de Jong & Ferguson-Hessler, 1996; Muller, 2014; Winch, 2013). According to these authors propositional knowledge forms the basis of epistemology and has been extensively discussed in literature. Discussions have shown that elements of acquaintance knowledge exist within propositional knowledge. In the early years of radiography education, the emphasis was on skills transfer and the application of those skills without or with limited knowledge of the theoretical propositional knowledge (Baird, 2008). The significance of propositional knowledge became evident when X-ray images had to be interpreted, and also when dealing with the safe use of radiation (Bentley, 2005). Early pioneers in radiography suffered extensive burns through the incorrect application of radiation due to lack of knowledge about radiation safety (Bensusan, 1967).

Procedural knowledge, namely practical knowledge or know how (KH), refers to practical knowledge or a demonstration on how to do something and requires the elements of both acquaintance knowledge and propositional knowledge (de Jong & Ferguson-Hessler, 1996; Muller, 2014; Winch, 2013). For students to be able to do or perform a procedure they need large elements of 'knowledge that' and fewer elements of acquaintance knowledge. A counter argument could be that certain procedures can be performed without KT, but research has shown that effective practical performance, especially that which is complex, requires 'knowledge that' (Muller, 2014; Winch,

2013). So it becomes necessary to bring all these kinds of knowledge into the curriculum and into the way academics conceptualise and teach the different elements.

Another theorist who generated research about knowledge was Bernstein through his theory of horizontal and vertical discourses (Bernstein, 1999). According to him horizontal discourses are context dependent and specific, and the procedures are organised into functionally related segments. In a simple form this refers to everyday knowledge or commonsense knowledge which all individuals have in their possession (Bernstein, 1999). In vertical discourses, however, the content knowledge and procedures are conceptually integrated. To effectively organise teaching strategies an alignment is important between the vertical discourses and the teaching strategies; without the knowledge of content knowledge this alignment may be compromised (Shulman, 1987). Content knowledge, which is also known as vertical discourse or professional knowledge, is the knowledge of the subject matter and its structures which is acquired from academic institutions (Nhlapo, 2012; Shulman, 1987). Ball, Thomas, and Phelps (2008) acknowledge the importance of content knowledge in the improvement of teaching and learning. They point out that attention needs to be focused on whether teachers understand the subject they are expected to teach.

Pedagogical content knowledge refers to teaching and learning theory that considers the specific learning demands and challenges associated with the subject matter (Loughran, Berry, & Mulhall, 2012). Pedagogical content knowledge is Shulman's theory that emerged in the 1980s and has been a subject of ongoing research for more than two decades with over 1200 refereed journal articles (Ball et al., 2008). Shulman (1987) claimed that pedagogical content knowledge includes the understanding of teaching strategies that are aligned with the content and also knowing how to arrange all elements of the content for better teaching. To effectively teach radiography, a lecturer must have the necessary professional content knowledge in addition to acquaintance, propositional and procedural knowledge. In other words a history lecturer would not be able to teach radiography students on how to recognise normal and abnormal patterns and interpret medical images.

Shulman defined PCK as

the blending of content and pedagogy into an understanding of how particular topics, problems, or issues are organized, represented, and adapted to the diverse interests and abilities of learners, and presented for instruction (Shulman, 1987.p.8).

There are important aspects that were highlighted in the definition, namely the content, pedagogy, students and the interconnection. PCK aims at bridging the gap between the content knowledge (subject matter) and the practice. Marks, as cited by Baker and Chick (2006), expanded the definition to include adaptation of the content knowledge to align with a specific context and referred to this as content specific pedagogical knowledge.

Curriculum knowledge refers to all information and documentation related to the programme and the qualification from the purpose statement, outcomes, graduate attributes, subjects or modules, topics, teaching and learning strategies, forms of assessments and instructional material (Winch, 2013).

## 2.4 WAYS OF KNOWING

Epistemological ways of knowing range from the description of empiricism and rationalism to include authority and intuition as stated by Muller (2009) and Parsons and Beauchamp (2012). Empiricism is based on experience. It deals with perception and observation with a strong belief that knowledge is based on observing facts thus it is objective. In rationalism, knowledge is influenced by reason and logic and does not depend on perception or sensory organs which may have limitations (Parsons & Beauchamp, 2012). Authority depends on the wisdom and knowledge of great people which may be flawed when those people are wrong (Huitt, 1998). It further depends on traditions and beliefs that many authorities are recognised and have been time tested for validation (Huitt 1998). Finally intuition, or inspiration or revelation, is inherent in everyone and enables people to have knowledge beyond the available sources (Huitt, 1998). In academic institutions, where students are taught by experts, the sources of knowledge are primarily from the lecturers, literature and all other available resource (Parsons and Beauchamp, 2012). Students are expected to actively engage in the

learning process in order to acquire the necessary knowledge (Parsons and Beauchamp, 2012). Teaching strategies employed by experts, such as lectures, and drawing on experts outside the academic institutions can help to ensure knowledge is acquired and retained by students (Parsons and Beauchamp, 2012). These teaching approaches and methods should be aimed at the holistic development of the students ensuring that they acquire the knowledge to think, and to perform with integrity. The lecture method is the oldest pedagogical form and is a widely used teaching strategy that has been employed by various academics in preparation of students for various qualifications (Musa, Musa, & Danjuma, 2015; Russell, Comello, & Wright, 2007; Sajjid, 2010). Teaching strategies employed in higher academic institutions, and in terms of healthcare related qualifications with emphasis on radiography, are the focus of the next discussion.

## **2.5 TEACHING AND STRATEGIES EMPLOYED IN RADIOGRAPHY**

Traditional education, in the early professional development around 1910, was skills driven minus the theory or with less emphasis on theory (Bentley, 2005; Price, 2001). Clinical education at clinical centres situated in various hospitals was how radiographers were trained and comprised the major component of their education. Student numbers were small and students were taught through demonstrations, observations and practice. Although there was emphasis on vocational skills training, rather than academic cognitive development, there was a strong relationship between instructors (Baird, 2008). Even when theory was introduced into the education, transferring theory to practice was easier since all occurred within the hospital environment (Bentley, 2005; Decker & Iphofen, 2005). The strong relationship between the instructors and students enabled the latter to develop strong work ethics and technical skills since they viewed the instructors as role models. Furthermore the instructors worked with students in the classroom, as well as in departments, which was effective in the integration of theory to practice.

The teaching strategies that were effectively employed can be closely aligned with Vygotsky's zone of proximal development (ZPD) and zone of actual development (ZAD) theories and scaffolding techniques (Shabani, Khatib, & Ebadi, 2010). Vygotsky defined ZPD as

the distance between the actual developmental level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance, or in collaboration with more capable peers (Vygotsky, 1978, p. 86).

Although scaffolding as a term was never used by Vygotsky it explained the process of development when students learnt from their interactions with more knowledgeable others (MKOs) until they in turn, could work independently (Shabani et al., 2010). By using what is aligned with the scaffolding technique, whether done consciously or unconsciously, meant the instructors provided the students with clear direction through step by step guidance on the expected goals of development to thus reach their ZPD. This was achieved through demonstration, role modelling and mentoring (Shabani et al., 2010).

#### .2.5.1 Current teaching strategies

Radiography education globally is challenged to ensure that graduates qualify with appropriate academic and competency skills or practiced based skills as noted by Ng and White (2005) and Mackay, Anderson, and Hogg (2008). Williams and Berry (1999) conducted a study to establish a model of standard competencies that had to be achieved by the graduating (qualifying) radiographers. Although the model only focused on diagnostic radiography, it can be applied to the other radiographic disciplines with slight modifications. Their results indicated that the following skills are the expected standard competencies:

- Professional behaviour means working according to the profession's code of conduct and maintaining appropriate high standards of professional approach and behaviour in all spheres of the work role.

- Health and safety is concerned with adhering to the rules and regulations of work place health and safety and most importantly all regulations pertaining to radiation safety.
- Clinical skills refer to the ability to perform and produce high quality diagnostic images in wide range examinations.
- Interpersonal skills refer to the ability to communicate effectively with patients, their family members and other healthcare workers.
- Professional knowledge includes all forms of knowledge, namely the acquaintance, propositional and practical knowledge that have to be integrated during clinical practice in order to perform and produce quality images.
- Patient care refers to the ability to deliver quality care to all patients before, during, and after the examinations.
- Technical skills refer to the ability to work and maintain all equipment and also to keep abreast with the advances in technology.
- Administrative skills include all tasks involved in the organisation and management of the departments.
- Teaching and learning refers to continued learning beyond obtaining the qualification.

In 2000 Williams and Berry predicted the addition of skills such as pattern recognition to take on tasks that are primarily the role of radiologists. The exit level outcomes of radiography qualifications registered with the Health Profession Council of South Africa (HPCSA) and the South African Qualifications Authority (SAQA) are closely aligned to the standard competencies that were researched by Williams and Berry in 1999. The difference is the addition of critical cross-field outcomes, which according to SAQA are problem solving skills, critical thinking, communication and working effectively in a team. Such skills are seen as generic skills for all graduates from any qualification.

The education institutions have to ensure that their teaching strategies are aimed at achieving the above competencies. The expected competencies can only be achieved by the application of academic theoretical knowledge in the workplace during clinical education. Furthermore, graduates are also expected to cope with the demands

associated with the forever expanding roles and responsibilities (Decker & Iphofen, 2005). Moreover there is a growing concern that technological changes, coupled with patient and industry demands, have resulted in some of the teaching practices of the past being incapable of dealing with the challenges of the 21st century (Engel-Hills, 2005; St. John-Matthews, Wright, & Osborne, 2014). The need to reform teaching strategies was observed by McMahon (2005) who felt that traditional teaching approaches needed to be revisited in order to enable allied medicine professions to cope with the 21<sup>st</sup> century challenges. This was reinforced by Decker (2009), who stated that institutions of higher education are still challenged to establish teaching strategies that can effectively balance academic and clinical components of the qualifications thus ensuring the graduates have the required competencies and are able to work independently.

There are various teaching strategies employed in the academic institutions for the cognitive development of students. The lecture method is the oldest and the most commonly used teaching strategy (Musa et al., 2015; Russell et al., 2007; Sajjid, 2010). It has received a lot of criticism for being teacher-centered when there is shift towards student-centeredness, thus resulting in students being passive learners rather than active learners. Russell et al. (2007) and Sajjid (2010) agree that the lecture method is used frequently when student numbers are large. Lecturers thus want to cover large amounts of content quickly, and they can offer the content in a structured manner. Sajjid (2010) offered tips on how the lecture method can be used to stimulate active student participation through use of examples, questioning and use of stimulating visual aids. Questioning strategies are advocated by Russell et al. (2007) as one of the effective methods to develop critical thinking, decision making and problem solving skills in students and to promote active learning. A point to note is that questioning can be effectively used in the lecture method and this highlights the fact that the lecture method does not necessarily have to be teacher-centered as it depends on the individual lecturer. In the current student-centered teaching environment, the role of a lecturer is facilitation rather than lecturing.

Group discussions, and individual presentations, are other teaching strategies which can be effective in engaging students in their learning (Musa et al., 2015). Group discussions do not necessarily have to be in the classroom, they can happen outside the classroom using online tools such as blackboard-social-networking. Individual presentations offer students the ability to research and gather information and present this information in the classroom. In these teaching strategies there is accountability, responsibility and visibility which are some of the concepts of signature pedagogies (SPs). Self-directed learning with self-evaluation are additional teaching strategies that promote active students learning as indicated by Russell et al. (2007). In self-directed learning students take ownership of their learning; through self-evaluation they can reflect on their strengths and weaknesses. The strength of SPs is that they advocate active student participation which enhances learning.

In 2014, Pieterse, Lawrence, and Friedrich-Nel investigated the problem solving abilities of third year radiography students at two institutions of higher education in South Africa. Their results indicated that students had very minimal problem solving skills. It is imperative to identify and employ teaching strategies that can effectively enhance problem solving abilities such as stimulating questioning strategies. Subramaniam (2006) and Russell et al. (2007) believe that problem based learning (PBL) is effective in promoting critical thinking and problem solving skills in students. In PBL the lecturers can use patient scenarios encountered in clinical settings and the students are required to search for the answers.

Case based learning is another strategy closely associated with PBL. Enquiry based learning (EBL) is similar to PBL. However, Naylor (2011) felt that using the term PBL insinuates that there is a problem. She evaluated this teaching strategy as pedagogy for teaching the science of imaging technology to radiography students in the form of group work, seminars and practical sessions. In order to develop critical thinking skills a scenario can be presented to third year radiography students. They are then asked to discuss the case, for example, the case of an 84 year old patient who clinically presents with transient ischaemic attack. The students' research has to start with the understanding of the pathology, risk factors, imaging studies that may be necessary and

the possible management which indicate a holistic approach. This approach, combined with real a case study, is employed in radiography education by lecturers where the study was conducted.

Innovative pedagogies have been developed, such as the artistic pedagogy, which has been investigated by Conway, Breen, McLachlan, and Fleming (2012) as the strategy to teach and reinforce anatomy in radiography students using body painting. This has been shown to improve creativity and students were able to retain anatomy knowledge. Advances in technology allow for effective blended teaching strategies to be employed in radiography teaching. The 21st century students are more technologically aware and are referred to as digital natives thus the use of technology greatly enhances learning and student participation (Lorrimer & Hamilton, 2009).

The blended teaching and learning approach, which is aimed at enhancing radiography students' control over their own learning, also enables them to actively engage in their learning within and outside the classroom, This approach was adopted in Ireland by McMahon (2005) and at Queen Margaret University in Edinburgh by Cockbain et al. (2009). St. John-Matthews et al. (2014) are of the opinion that technology enhanced teaching, using the blended teaching and learning approach, utilising tools such as podcasts, blogs, wikis, flash presentations, vodcasts and or discussion boards, allows for active student discussions. Benefits of this pedagogy were noted by Lorimer and Hilliard (2009) who observed an increased level of student engagement when they employed blended teaching and learning strategy. Bleiker, Knapp, and Frampton (2011) found this pedagogy beneficial in teaching patient care to first year radiography students. The blended teaching approach is employed by a number of lecturers at DUT where the current study was conducted. Most senior lecturers in radiography employ the blended teaching approach and engage with students using tools such as wikis, blogs, podcasts and discussion boards in the online classroom.

Simulation teaching strategies are extensively employed in various fields; such as aviation, military, medicine and other allied healthcare professions (Lateef, 2010; Ziv, Small, & Wolpe, 2000). In aviation, pilots learn the basics through simulation before being allowed on the aircrafts. Healthcare professionals are able to develop knowledge,

skills and attitudes without compromising patient safety through use of simulations (Lateef, 2010). Trainees are able to practice until they have mastered the skill or technique. Simulations have proved effective in developing skills in procedures that require eye–hand coordination, and in those that call for ambidextrous maneuvers, such as the ability to operate medical equipment (Lateef, 2010). There are various simulation tools used in health care education: mannequins, organ models, animals, cadavers, full body human skeletons and technology related software, for example (Ziv et al., 2000). These researchers further state that simulation based training techniques can be organised as structured learning experiences and they can also be used as assessment tools linked to specified competencies and learning goals.

The traditional simulation tools, such as full body mannequins and human skeletons, whole body skeletons or parts thereof, are still currently employed to teach radiography students a wide range of examination techniques at academic institutions before students encounter real patients in clinical settings. In addition group simulated teaching is employed, in activities where students practice their skills in groups simulating real examinations in X-ray departments without using ionising radiation. This means they practice the techniques of performing the procedures and prepare the equipment as in a real life situation. They however do not activate equipment to release ionising radiation to make the image. Technology advances have resulted in a number of computer-based software simulation programmes that can be used effectively in enhancing student learning and reducing lecturer contact time. In diagnostic radiography a number of programmes exist and have been evaluated to establish their effectiveness (Bott, Wagner, Duwenkamp, Hellrung, & Dresing, 2009). Simulated ultrasound units have been developed to aid students in developing eye–hand coordination and practicing skills before engaging with patients (Sidhu, Olubaniyi, Bhatnagar, Shuen, & Dubbins, 2012).

Some teaching and learning strategies that are employed in radiography education have been discussed. Some of them have strong indicators of SPs. In order to address the main research question it is important to discuss the theoretical framework that has informed this study.

## 2.6 THEORETICAL AND CONCEPTUAL FRAMEWORK

The theoretical and conceptual framework guiding this research is informed by Shulman's (2005) SPs and it is orientated in the interpretivist paradigm.

### 2.6.1 Signature pedagogies

Signature pedagogies (SPs) emerged as a focus of academic reflection with the publication of *Signature Pedagogies in the Professions* by Shulman in the Summer Daedalus of 2005. This theory inaugurated a series of debates about SPs, which are understood to be characteristic modes of teaching and learning that are unique, distinctive and which educate and prepare graduates for a particular profession. Clinical ward rounds were identified as the unique and classic method of the way in which medical students are inducted and educated for their roles as physicians; case studies, however, were recognised as the SP in the preparation of law students for their future roles as lawyers (Shulman, 2005).

As elaborated by Lee Shulman in his various publications (2004a; 2004b) in teaching and learning SPs for the profession have distinctive features including:

- Routinised and almost ritualistic approaches to teaching and learning designed to introduce students (novices) into the ways of thinking and being in a particular profession.
- Foregrounding the mastery of theoretical and conceptual facts underpinning disciplinary knowledge while paying equal attention to practical ways in which the acquired knowledge, skills and competencies could be used especially in practical professional situations.
- Constantly reminding students (novices) that the profession for which they are being prepared have a signified moral and ethical dimension. Using SPs is a process of systematic 'character formation.'

In his lecture delivered on Shanghai in 2013 Shulman provides a succinct yet comprehensive definition of SPs when he defines professional education as a

“ synthesis of three apprenticeships: a cognitive apprenticeship where in one learns to think like a professional, a practical apprenticeship where one learns to act like a professional and a moral

apprenticeship where one learns to think and act in a responsible and ethical manner that integrates across all three domains”.

Needless to say this conception of professional education resonates with both the theory and practice of pedagogy in the various health care professions including radiography. This theory of SPs generated not only a series of debates but also a lot of criticism. On 14 June 2012 Shulman posted on his Blog that he had ‘let loose to the academic world a theory that was still underdeveloped and in its infancy’. He promised to write a series of essays to create a better understanding of the theory and its concept ‘as he now understands it’. It is assumed by the researcher that Shulman is still working on those essays, since they have not yet been published and as such the original, much debated theory still holds.

Studies by the Carnegie Foundation, which advocated case studies as SP for the preparing of future lawyers, were challenged by Terry (2009) who felt that the pedagogy was not adequate in the development of professional identity and integrity. She then proposed externship which she described as the SP for professional identity and purpose. She further provided guidelines as to how this could be incorporated into the curriculum. The criticism that has been raised indicates that students are taught how to act and perform as lawyers but with less emphasis on professional integrity. It can be argued that this appears to be in contrast to Shulman’s theory of SPs, which is characterised by pedagogies of formation, meaning they teach habits of the heart. Habits of the heart, according to Shulman, are aimed at teaching ethical behaviour, morals and values of a specific profession.

Studies have also shown that SPs were subsequently identified in the education of engineers, church ministers, and various other professions such as social work, education and nursing (Swanson-Cornell, 2012; Wayne et al., 2010). Wayne et al. (2010) explained that central to Shulman’s SPs is the goal to connect and integrate the profession’s theory and practice. Their paper evaluated field work in social work to look for characteristic features of SPs. Sappington, Baker, Gardner, and Pacha (2010) agreed with Wayne et al. (2010) and stressed that SPs integrate professional knowledge, and are the key values in distinctive teaching learning and assessment

approaches. They further stated that the aim is to develop critical reflective skills in students which they term 'practical wisdom'. Integrating technical theoretical knowledge, critical reflective skills, core values and practical skills, is the ultimate goal in the development of future radiographers. Wayne et al. (2010) pointed out that SPs tend to focus on some aspect of the profession and exclude others. This was observed by Swanson-Cornell (2012) who argued that field placement was not enough and social work education needed a much more comprehensive SP. They advocated the inclusion of cognitive development, promotion of ethics and values, and lastly field work. Fieldwork in radiography is referred to as clinical education or workplace learning. Until recently this fell under the broad umbrella of work integrated learning, specifically in South Africa.

Long et al. (2012) discussed a range of SPs that were aimed at promoting competency and care in nursing education such as the narratives, problem based learning, clinical education, simulation, and what they felt was an emerging of pedagogy international placements aimed at exposing students to broader experience. In addition liberal arts pedagogies were adapted into the nursing education context with the aim of promoting critical thinking skills and to educate nurses on how to act ethically and compassionately in their profession. Nursing education has close links with other allied healthcare professions, and as a result they all share some pedagogy however within the context of the specific discipline.

Occupational therapy (OT) is another allied health care field that has published literature about SPs in their professional education. According to Schaber, Marsh, and Wilcox (2012) there are three traditional SPs in OT: relational, affective and contextualised learning. Relational learning emphasises the relationship between a lecturer and a student which is beneficial in the development of 'emotional intelligence' through story telling or sharing of stories and in promoting professional identity. Relational learning is achieved through mentorship, apprenticeship and modelling in and outside the classroom (Schaber et al., 2012). They further state that the aim of affective learning is to initiate change in students' attitudes and beliefs through involvement with topics and scenarios that teach empathy and grief.

OT students are inducted into the profession through contextualised learning and active participation or engagement in their education either in or outside the classroom. The emphasis is on 'learning by doing' through using a variety of teaching methods such as case studies, problem based learning, simulations, classroom practice sessions, practical exams, in-class activities, which can be group presentations, lecturer demonstrations followed by students practice and service-learning (Schaber et al., 2012). Moreover, these authors identified emerging SPs which are in line with the changes in the environment and advances in technology. They propose use of online activities and hybrid learning (blended learning) to facilitate story sharing and other learning activities.

Education research conducted both in undergraduate and post-graduate doctoral studies, demonstrates the evaluation of generic pedagogies within the context of education in order to identify SP (Golde, 2007; Jenkins, 2012; Meyer & Shannon, 2010). Golde in 2007 explored the value of adapting two teaching approaches, namely, the journal club from neurosciences, and the list from English studies as possible SPs in doctoral education in order to improve and enhance critical analysis of literature in doctoral research students. As stated by Golde (2007) the journal club teaching approach involves formally organised groups comprising advanced faculty researchers and new graduate students. He further stated that the groups meet at regular interval where one person is selected to present a recent article which is followed by group discussions. According to Golde (2007) the value of this approach lies in the fact that students learn how to critically review and analyse articles, do formal presentations and be part of in-depth participation and discussions. The list approach employed by the English studies is a collection of 60 to 100 works or texts where one work may include a selection of poems, a novel theoretical work or a group of secondary sources. The students are expected to write an examination based on the content of the list to demonstrate that they have mastered the literature of the field ( Golde, 2007).

Other generic pedagogies that have been investigated include participatory action research, case writing, and class discussions, as SPs in education leadership modules (Jenkins, 2012; Meyer & Shannon, 2010). This is a noticeable shift from studies that

focused on pedagogies that were as distinct as the medical ward rounds with less emphasis on the other characteristics of SPs. At the initial stages of the current study a heavy emphasis was placed on identifying characteristic features that simulated medical ward rounds within the radiography education which almost flawed the results of the study.

According to various authors, as indicated by Gurung, Chick, Haynie, and Publishing (2009), SPs have been investigated in other nonprofessional fields such as fine arts, social sciences, natural sciences, and in other school activities. In this chapter SPs related to professional education have been discussed. Although extensive research studies have been conducted and debates are still ongoing in other professions the researcher has not been able to find literature which indicates that SPs have been explored in radiography education internationally or locally. Shulman has shown how this approach to teaching and learning encapsulates the principles of clinical education in radiography, which requires students to be systematically and pragmatically introduced to knowledge and practice of the profession through the integration and application of theory in clinical situations.

## **2.7 CONCLUSION**

This chapter provided a discussion of the literature relevant to the study. The reviewed literature included an overview of the history of radiography education, knowledge and forms of knowledge pertaining to the profession. Teaching and learning strategies employed in radiography education, such the lecture method, class discussions, questioning, blended teaching and learning, simulation and Shulman's theory of signature pedagogies (SPs), were discussed. The next chapter discusses the research design and methodology used in this study.

## CHAPTER THREE: RESEARCH DESIGN AND METHODOLOGY

### 3.1 INTRODUCTION

This chapter describes the research design with emphasis on the interpretivist paradigm and qualitative research methodology that were employed in this case study. It also describes data collection methods that were used namely individual interviews, observations, and document analysis. Ethical considerations and participant selection criteria are discussed.

### 3.2 RESEARCH DESIGN

This study is situated within the interpretivist paradigm. Interpretivist researchers argue that reality comprises people's experience of their outside world and that reality is socially constructed (Thomas, 2010). This paradigm emphasises the ability of an individual to construct meaning (Mack, 2010). Thus interpretivist researchers are guided by participants' subjective views of a situation being studied. The main aim of interpretivist research is to understand the phenomena through meanings that people assign to them according to Deetz, as cited by Thomas (2010). This may prove a challenge for a researcher when trying to engage in many interpretations. Good observational skills are required. In this study the researcher listened and observed the participants, and then tried to decipher the meaning of their words and behaviour. As an example the understanding of self-directed learning had different interpretations and different ways of implementation among the different participants. In contrast to the positivist research, research is conducted in a natural setting and not in a laboratory environment (Maree, 2007). The lecturers in this study were interviewed in their offices. Observations by the researcher were conducted in their lecture rooms. The researcher visited all participating clinical training centres to interview the clinical coordinators.

Interpretivist researchers believe that knowledge is gained through personal experience hence the dependency on participants' subjective views. They further argue that the role of the interpretative paradigm is to acquire knowledge by investigating the situation or event in many ways as the social context is different from natural sciences (Mack, 2010). There are however numerous criticisms of this paradigm. The general assumption is that events are specific and cannot be generalised. This means therefore that the obtained results cannot be generalised. For this reason results obtained from this study were not used to make a general statement about radiography education nationally.

The issue of subjectivity means different researchers can have different results and conclusions for the same observation (Koul, 2008). Furthermore, a researcher's own subjective interpretation may flaw the research. In order to overcome this problem, member verification of the obtained transcribed data is essential (Maree, 2007; Koul, 2008). The argument in support for this paradigm is that maintaining quality standards of trustworthiness, dependability and authenticity may reduce subjectivity of the obtained results and improve credibility of the research process (Koul, 2008). Koul (2008) further explained that trustworthiness has qualities such as credibility which can be verified through member checking, and transferability which is associated with a thick description of the emerged themes. He further included two additional qualities: dependability and conformability.

In this study measures were taken to ensure that quality standards were maintained. All interviews were transcribed and sent to all participants for member checking to verify and ensure that what had been transcribed was correct. Thick descriptions of collected data were written. An independent person was asked to check the data as an outside viewer in order to ensure quality of the research process.

This was a qualitative study which was associated with interpretivist paradigm. The aim of qualitative research is to understand social life and meaning that people attach to everyday events using research methods such as interviews, observations, document reviews and visual data analysis (Mackenzie & Knipe, 2006; Maree, 2007). Three research methods were used: individual interviews; classroom observations; and document reviews. The objective of qualitative methodology is to investigate what people feel and think, and it is also about obtaining information about feelings and impressions rather than numbers (Maree, 2007). The negative aspect of this is that a researcher has to deal with the assumptions of what people feel and think rather than their real true feelings and thoughts (Maree, 2007). In this study there were situations where participants stated what they assumed what the researcher wanted to know rather than what they thought or felt about the situation. For example, graduate attributes are a current topic, but participants' answers about graduate attributes sometimes tended to echo the current trend rather than the reality. This study focused on a specific department within the university, and within this department, thus further positioning this research as a case study within the interpretivist paradigm.

Case study research allows for the selection of a small geographical area, small unit or few numbers to participate in the study, and it can be versatile in the terms of data collection tools (Rule & John, 2011; Zainal, 2007). By selecting a small area or unit, a researcher can work closely with participants and thus be able to closely examine the data within a specific context (Maree, 2007; Zainal, 2007). In addition a single case study allows for simple manageability as compared to complex multiple case studies. As stated by Rule and John (2011), case study research allows for in-depth exploration of a phenomenon with flexibility and can form the base or platform for further research. There are seven South African universities that offer radiography education. For the purpose of this study one institution (university) was selected to be the focus of this research. Furthermore only a specific department within the institution in the study was selected. The study also focused on the selected department's teaching and learning strategies. Although the focus was one institution, it is a starting point which may expand nationally as a follow-up project to include other institutions that offer radiography education.

In addition multiple sources of data collection were used in line with qualitative research methodology. As stated by Mackenzie and Knipe (2006) good research studies tend to be small scale with small sample sizes.

### 3.3 SAMPLING METHOD AND SELECTION CRITERIA

There are two sampling methods: probability and non-probability. Each method has various elements. Probability sampling methods are generally used when the sample represents a wider population and the obtained results can then be used for validity and generalisation (Maree, 2007). Non-probability sampling methods, on the other hand, cannot be used for generalisations. The reason being is that they do not represent the whole population and are thus used in small scale research. This study was small scale hence non-probability purposive sampling method was used.

However, purposive sampling method was used in the selection of participants. Purposive sampling is also referred to as judgement sampling since it is a deliberate choice of participants due to specific qualities that they possess (Tongco, 2007). A researcher determines the research problem and information needed to solve it, then hand picks or select willing participants depending on their knowledge and or experience, which are the qualities they should or should not possess (Tongco, 2007; Cohen, Manion, and Morrison, 2011). The focus in purposive sampling is on specific issues. It tends to have greater depth but less breadth, since the goal is to select people who have in-depth knowledge about a particular issue (Tongco, 2007; Cohen et al., 2011). Maintaining the importance of reliability and competency, when evaluating potential participants, is crucial considering that their selection is based on defined qualities, hence the issue of bias associated with this sampling method (Tongco, 2007; Cohen et al., 2011). These authors stress the importance of using appropriate data collecting methods. In situations where it is not possible to get the required number of participants, a variation of this sampling method may be used and is referred to as the boost method in order to include participants who were excluded (Cohen et al., 2011).

The selection of academic participants was based on their highest postgraduate qualifications and years of academic experience. The minimum qualification for inclusion in the study was a master's degree combined with ten or more years academic

experience. Three lecturers were selected to participate in the study as they met the selection criteria thus signifying depth of knowledge. The selection of clinical coordinators was based on years of clinical teaching and mentoring as well as clinical experience. The minimum requirements were ten years or more of clinical coordination (clinical teaching and mentoring) experience and or fifteen years or more clinical work experience. In terms of these selection criteria, ten clinical coordinators participated in the study. The defining qualities that guided their selection were depth of knowledge based on years of experience either in academia or clinical setting combined with qualifications with regards to the lecturers.

The department of radiography offers four radiography programmes. These are diagnostic radiography, which is the major component, and three smaller radiography disciplines: radiotherapy, nuclear medicine, and ultrasound. Lecturers and clinical coordinators of the first three programmes, who met the selection criteria, were included in the study. The ultrasound programme was excluded because the researcher is the lecturer and coordinator of this programme at the study site.

Radiography education, nationally and internationally, includes workplace learning. Nationally workplace learning is conducted in clinical centres that have been officially accredited by the Health Professions Council of South Africa (HPCSA). There are forty-nine HPCSA accredited clinical centres in Durban and Pietermaritzburg. Data were collected from clinical coordinators at six clinical centres (n=6) in Durban. Selected clinical coordinators were chosen in line with purposive selection criteria. The study was conducted at four public hospitals, and two private radiology practices, in Durban (n=6). Permission to conduct the study was not obtained in one public hospital and one private radiology practice thus these were not included in the study. There are clinical training centres in Pietermaritzburg, but these were excluded because they did not meet the selection criteria. Their inclusion would therefore have challenged the credibility and validity of the study.

### 3.4 PILOT STUDY

The interview questions were sent to the researcher's supervisor for evaluation prior to the pilot stage. The supervisor reviewed the questions and suggested amendments. The questions were only finalised after corrections had been made. The purpose of the pilot study interviews was twofold. First, it was to establish whether the questions were aligned with the research questions. Second, it was to establish the accuracy, appropriateness and relevance of the questions. Initially the proposed plan was to interview two lecturers from the service department, but unfortunately their response to the first question would have compromised the study. Two junior lecturers from the department, who had five years academic experience, were then selected for the pilot study. The answers obtained from them verified that the questions were relevant, accurate and appropriate for addressing the research questions.

### 3.5 DATA COLLECTION

Three forms of data collection processes were employed: individual interviews, classroom observations, and document analysis. Oral data were collected in the form of semi-structured interviews. According to Cohen, Manion, and Morrison (2011), structured interview questions are in-depth and are prepared in advance. In semi-structured interviews there are only a few pre-determined questions which allow for probing and clarification of answers. According to them probing can be classified as detailed-oriented, elaboration and clarification probing. Probing questions in this study were used to elicit additional information or to seek clarity on the obtained answers. Probing questions were not always similar since these were dependent on the answers provided by the participants.

A few pre-determined questions were used for all interviews as indicated in Appendix A. The aim of these questions was to obtain information that addressed the first research question, and to enable the researcher to explore and identify existing signature pedagogies (SPs), employed by the lecturers. The latter thus addressed the second research question. The interview questions were also aimed at identifying the presence or absence of key concepts or characteristics of SPs in each participant's responses.

The interviews were scheduled for 45 minutes to an hour per participant; however most interviews lasted less than 30 minutes.

The questions to the clinical coordinators were slightly different to those used for the academic staff. Information obtained from the clinical coordinators helped to support or dispute the second research question. The argument being that if there are identifiable SPs, these should be reflected in a student's performance in the workplace. The ten clinical coordinators' one-on-one interviews were only conducted on after permission was obtained from the Department of Health, KZN, and the selected private radiology practices.

The procedure for conducting one-on-one interviews was similar for all participants. All interviews were conducted within each participant's natural setting, such as offices in the relevant workplaces. Prior to interviews taking place the researcher briefly explained the research study. All participants were then asked to read the informed consent letter and to sign the declaration form. Permission was also obtained to audio record the interviews using a digital audio recorder. During the interview the researcher, in some cases, also took limited notes which enabled reviewing of answers. These notes were helpful in terms of the researcher asking additional questions or clarifications at the end of an interview. The researcher sent the 10 clinical coordinators' audio recorded interviews to a professional company for transcribing.

As stated above, case study research involves multiple forms of data collection. In this study additional data collection methods comprised classroom observations for all academic staff and document analysis. Observations are more than watching the behaviour of people or an event unfold. They are a systematic process that allows a researcher to collect real data from natural settings (Cohen et al., 2011; Punch & Oancea, 2014). Observations are based on a continuum that ranges from structured to unstructured; structured observations can be further classified as either highly structured or semi-structured (Cohen et al., 2011; Punch & Oancea, 2014). Structured observations are best suited for quantitative research and involve prior prepared checklists and systematic planning. A researcher's objective is to test a pre-determined hypothesis. Highly structured observations can be rigid whereas semi-structured

observations are less stringent. In unstructured observations the use of prior checklists is not necessary (Cohen et al., 2011; Punch & Oancea, 2014). Unstructured observations enable a researcher to gather rich descriptions of situations, and are thus suitable for qualitative research. As stated by Robinson in Cohen et al. (2011) observations are ideal in situations where a researcher wants to verify whether the participants were actually doing what they claim to do. Classroom observations, as a data collection method, were important in this study. They were used to verify that the teaching strategies employed by the academic staff were aligned to the answers obtained from the interviews. As there were 10 clinical coordinators in various locations, clinical observations of them were excluded in this study.

Observation can be either overt or covert, self-observation or observation of others, and participative or non-participative (Punch & Oancea, 2014). This study involved overt or direct, non-participation observation of others. The researcher sat at the back of the classroom to observe classroom activities, but ensured that she did not cause any obstruction (Rule & John, 2011). Moreover a semi-structured observation was used. A checklist was compiled prior to an observation. The teaching strategies in the observation checklist were extracted from each participant's interview transcripts. The list of teaching methods was also adapted from Sajjad's (2010) list of effective teaching methods in higher education. Other teaching approaches were obtained from the teachings methods adopted by Jenkins (2012) (refer Appendix B).

The research process had its own challenges that were encountered during classroom observations. The department's academic year is structured in blocks of two to three weeks at the university, and two to three weeks at the clinical sites for workplace learning. The scheduling of classroom observations had to be negotiated with the participants and had to be taken into consideration. Negotiating suitable times was affected by unavoidable clashes in lecture timetables between the researcher and the participants. This resulted in a compromised situation with the researcher observing part of a lecture and re-joining it later towards the end of the period. Some participants were conducting their last lectures for the year thus classroom observations had to be done

to avoid extending the data collection process into the following year. These challenges of observations are discussed as part of the limitations of the study.

Document analysis has been defined as a systematic examination of instructions documents; it tends to be very useful when evaluating the quality of a programme (Maree, 2007). Document analysis in this study was not used to evaluate the quality of the programme. It was however used to review the curriculum documents, especially the SAQA and HPCSA documents that were submitted when the qualifications were registered. In addition study guides, clinical manuals, and clinical logbooks, were also reviewed. The SAQA documents for the three programmes were evaluated in order to establish the exit level outcomes and assessment criteria of the qualifications to verify their alignment with the teaching and learning strategies. The selected study guides and schemes of work (SOW) for 2014, and only the subjects that the participants were involved with, were evaluated. It would not have been beneficial to go through the study guides for all subjects in the department.

### 3.6 DATA ANALYSIS

The analysis of the data may include many direct quotations from participants and extracts from documents in order to illustrate and substantiate arguments (Cohen et al., 2011). In this study data were analysed according to the source, then the analysis was integrated with the study's theoretical and conceptual framework, and also with literature discussed in chapter two.

This section provides a description of how the themes leading to the assignment of various categories were constructed from the collected data. Data analysis was constructed from an in-depth analysis of the curriculum documents, study guides and notes from classroom observations and interview transcriptions. The process involved reading the documents, notes and transcripts several times to identify key ideas, similarities and common phrases. This was followed by summarising these into categories for analysis. It was essential that the essence of what the data reflected was not compromised. In terms of interview transcripts additional follow-up discussions were conducted to clarify certain aspects.

### 3.7 ETHICAL CONSIDERATIONS AND PERMISSION

Ethics clearance was obtained from the University of KwaZulu-Natal's Ethics Committee in terms of verifying that all research ethics processes were in line with the institution's guidelines (refer Appendix C). Permission to collect data at Durban University of Technology (DUT) was obtained from its research and post graduate support office. This was done to verify that all submitted documentation was aligned to the institution's research ethics and that issues of confidentiality and anonymity were going to be maintained (refer Appendix D). In addition the researcher had to obtain permission from the department where data was to be collected prior to conducting interviews or starting the study.

Ethical approval was also obtained from the Department of Health (Health Research & Knowledge Management sub-component), and permission was obtained from the research offices of all the hospitals under the Department of Health (refer Appendix E). The Department of Health had to verify that the study was not going to compromise vulnerable subjects, nor interfere with service delivery. Permission was also obtained from the private radiology practices.

Informed consent was obtained from all the participants (refer Appendices F and G). Issues of confidentiality and anonymity were clarified before the consent form was signed by each participant. All collected data from the participants was stored under lock and key in the researcher's office. The participants' personal information and any details that could be used to identify the participating selected clinical training sites in both the private and public sector was safeguarded.

### 3.7 CONCLUSION

This chapter described the research design and methodology used in this study. The sampling method and selection criteria were explained. Ethical considerations and procedures that were followed in obtaining permission to perform the study were presented. The next chapter discusses the research findings.

## CHAPTER FOUR: RESEARCH FINDINGS AND DISCUSSION

### 4.1 INTRODUCTION

The previous chapter focused on the research design and the methodology used in this study. This chapter provides an analysis of the collected data and presentation of the findings. The initial discussion details how the themes and categories in the study were constructed. This is followed by a detailed presentation of the findings obtained from reviewing the institution's qualifications' curriculum documents, and from the study guides for subjects that are taught by the lecturers that participated in the study. Following on this is an analysis and presentation of the interview transcripts, combined with notes from the classroom observations, where applicable, is discussed. Verbatim comments from participants are presented in italics.

### 4.2 DOCUMENT ANALYSIS

#### 4.2.1 Curriculum documents

The curriculum documents had to be reviewed first since they provide the learning outcomes, standards and core competencies that qualifying graduates should demonstrate before being awarded their radiography qualifications. Competencies, as defined by Jackson (2007), are knowledge, skills and abilities that a person possesses and demonstrates which are aligned with occupational standards of a particular profession. Furthermore these documents incorporate the content, teaching strategies, forms of assessments, and assessment criteria. They are the official and documented face of the curriculum which may or may not be different to what actually happens in the classroom. They provide the blueprint for possible teaching strategies and also insight into the types of pedagogies that are common in the discipline ( SAQA, 2013) In addition they provide the underlying assumptions about teaching and learning which will be used to structure educator activities and which researchers can engage with critically (SAQA, 2013). The other purpose of reviewing these documents was to verify that graduate attributes, the industry expectations, as well as the teaching and learning strategies, are all aligned. The qualification exit level outcomes and specific outcomes should be closely aligned or congruent with both graduate attributes and qualification expectations from industry as indicated in the curriculum documents. The latter are

lodged and approved by the Department of Higher Education and Training (DHET), registered with SAQA who approves the learning outcomes, and the HPCSA that provides the preliminary approval. The HPCSA, as the regulatory body, conducts regular quality assessments in all academic institutions that offer radiography education to ensure that the quality of the provided education is in keeping with professional standards.

The curriculum documents, pertaining to radiography programmes, which the institution registered with SAQA and HPCSA, were reviewed. These were for National Diploma Radiography: Diagnostic; National Diploma Radiography: Nuclear Medicine, and National Diploma Radiography: Therapy. The specific outcomes of all exit level outcomes were analysed and the collected data, across all three disciplines, were assigned into specific categories. Exit level outcomes, as defined by SAQA, refer to the outcomes which define the level of performance according to which a candidate completing the qualification is (SAQA, 2013).

Final year students are expected to demonstrate competencies that include all specified categories. The categories that emerged were: clinical skills, technical skills, professional knowledge, health and safety, professionalism, professional ethics and patient care, managerial skills, and generic critical cross-field outcomes as displayed in Table 4-1, which provides a summarised version of the description of all categories.

**Table 4-1** Exit level outcomes categories

Category	Description
Clinical skills	Ability to: Evaluate the referring clinician's request form or notes. Establish the appropriate techniques and protocols to be employed to effectively examine or treat the patients. Competently perform the examinations at the expected high standards. Identify normal and abnormal patterns in all produced images.
Technical skills	Competently operate medical equipment and accessories. Perform quality control procedures on all related equipment.
Professional Knowledge	Application of knowledge scientific knowledge when performing procedures
Health and safety	Adherence to Radiation Control Board's rules and regulations. Ensure radiation safety and protection to all patients under their care as well as the public. Maintain a safe environment for all people under their care.
Professionalism	The conduct, aims, or qualities that characterize professional person.
Professional ethics and patient care	Are the personal and standard rules that govern behaviour within the radiography profession  Care for the patient responsibly and effectively
Managerial skills	Competently performing administrative and managerial functions appropriate to the entry profession level.

The curriculum documents indicated that the profession has a very strong practical component, and that the required skills or competencies cannot be achieved solely in the classroom. Thus education in the clinical centres is essential. In South Africa this occurs mainly in clinical facilities that are accredited by the HPCSA.

#### 4.2.2 Study guides

An analysis of findings obtained from the study guides is presented in this section. Study guides reflect the individual lecturer but also link to the official documents. The discussion of the findings is incorporated with the discussion and presentation of interview transcripts for all lecturers. This aided in establishing the alignment of the study guides' teaching and learning strategies with the interview transcripts. An

analysis of the findings obtained from evaluating individual subject study guides indicated the subject outcomes, teaching and learning strategies, content, assessment criteria, and forms of assessments, including their individual weighting for each assessments, which is used for the calculation of the final mark. Common teaching strategies were identified in the evaluated study guides. For example, the traditional lecture method, assignments, group projects, worksheets and work integrated learning in clinical training centres. Based on the evaluated documents, work integrated learning (WIL), which is referred to as clinical education in this study, was identified as the most common and major component in radiography education.

For anonymity, and to maintain confidentiality, all participants were assigned either numbers (clinical coordinators) or letters of the alphabet (lecturers) and referred to as Participant 1 or Participant A, for example. Participant A's study guide revealed employment of several teaching and learning strategies: self-directed learning, blended learning approach, lectures, practical work, assignments, portfolios, case studies, and experiential learning in clinical training centres. The study guide of Participant B revealed employment of several teaching and learning strategies in the classroom: lecture, interactive tasks, practical work, assignments or group projects and experiential learning (WIL) or clinical education in the hospitals. The teaching and learning strategies, as evident the study guides of Participant C, are the following: lectures, group work, presentations, demonstrations, worksheets and experiential learning in the hospitals. It needs to be pointed out that since the data was collected in 2014, there have been changes in the subjects that Participants B and C lecture. It was therefore not possible to evaluate the study guides of their current subjects since these were not compiled by them and this might have resulted in conflicting statements. Consequently all study guides that were not compiled by the participants in the study were excluded. All the analysed study guides indicated that the profession is strongly skills, or practice based, and that these skills can only be achieved during clinical education in the hospitals. The identified teaching and learning strategies are discussed in-depth in the next section in combination with interview transcripts.

## 4.3 INTERVIEW FINDINGS

### 4.3.1 Lecturers

Before embarking on the discussion it is important to reflect on one of the core functions of academic institutions, especially the universities of technology (UoTs), which is to ensure that graduates are properly qualified to be employable. Employable means that graduates possess the required skills or competencies to perform the jobs or professions which they have been educated for (McCabe, 2010). With reference to radiography as a profession there are core skills or competencies that graduates have to possess before they are granted the qualification. These competencies or skills are documented in the curriculum documents as registered with DHET, SAQA, and the HPCSA. The goal of radiography education is to ensure that graduates work with minimal or no supervision from onset post qualifying (Williams & Berry, 1999). It is thus essential that graduate attributes, and all activities related to the education of radiography students, are considered when selecting and deciding on teaching and learning strategies. With this in mind, the lecturers were asked to indicate the core graduate attributes they expect final year student to possess when they graduate. There are a number of definitions of graduate attributes. The definition that has been adopted by the institution is by Bowden as indicated in the paper presented to the university senate by head of Centre for Quality Promotion and Assurance (CQPA) in 2014.

The qualities, skills and understandings a university community agrees its students would desirably develop during their time at the institution and, consequently, shape the contribution they are able to make to their profession and as a citizen. These attributes include but go beyond the disciplinary expertise or technical knowledge that has traditionally formed the core of most university courses. They are qualities that also prepare graduates as agents of social good in an unknown future Bowden et al. cited in McCabe (2010).

The categories that emerged from the analysis of findings of this study indicated that the core graduate attributes were sub-divided into hard and soft skills, in addition to the generic attributes that all graduates should possess. The core graduate attributes relate to the profession's competencies that graduates should possess, and the generic attributes that are common across all qualifications within the institution. The graduate attributes are indicated in the Table 4-2 below.

**Table 4-2.** Graduate attributes

Hard skills	Soft skills	Generic
Professional knowledge	Honesty,	Self –motivation
Clinical skills	Empathy	Lifelong learning
Technical skills	Values and morals	<ul style="list-style-type: none"><li>• <b>Critical cross field outcomes:</b> communication, problem solving, decision making, technology and critical thinking.</li></ul>
Professionalism	Integrity and respect	

There was consensus among the participants in terms of the main core attributes that all graduates should possess. Professional knowledge was identified as the most important attribute, followed by clinical skills, technical skills, and professionalism, which includes professional behaviour, conduct as well as strong work ethics. All participants indicated that soft skills, also referred to as humane values, were essential. Participant B, however, strongly felt that soft skills needed to be reinforced in students due to feedback and comments from industry, which indicated that although the graduates are competent in clinical and technical skills. According to Participant B, radiography student demonstrated limitations in the soft skills such as empathy and kindness towards patients as per an interview comment below.

*but I think the values and moral those kind of soft skills are important as well but more important cause when we get feedback from the hospitals they don't complain about the student's technique they complain about their attitude and the way they treat the patients SO it is very seldom we get any feedback that says they don't know how to do XRAY(Participant B, I: 9).*

Soft skills are essential as a professional requirement, because the possession of hard skills without soft skills does not make a competent, caring radiographer (Fortsch, 2007). The profession expects high values and strong ethics when dealing with members of the public as well as working in a team with other healthcare professionals. In addition generic attributes are as essential in radiography as in other professions. Although problem solving, reflective practice, and critical thinking skills are generic

attributes, several researchers have noted that these attributes need to be developed in all radiography students (Baird, 2008; Kowalczyk et al., 2012; Pieterse, Lawrence, & Friedrich-Nel, 2014). Following on this, the participants had to indicate the teaching and learning strategies they employ that are aimed at ensuring that all or most of the attributes are achieved.

An analysis of interview transcripts indicated identified teaching and learning strategies when evaluating the transcripts of the participants. These are discussed and then followed by the presentation of the results. The latter are combined with the findings from study guides as well as notes from participant classroom observations. The combined teaching and learning strategies employed by the all participants are as follows: lecture method, self-directed learning independent learning, blended learning approach, individual presentations, innovative assessments, role modelling, demonstration, storytelling, simulation, edutainment, worksheets, self-study, active participative teaching, group activities, and collaborative engaging learning.

The lecture method was identified as a common teaching strategy in all analysed study guides. However, according to the interview transcripts not all participants indicated that they employ this approach in their classrooms. The lecture method was not used by Participant A, who stated:

*basically all of my lectures, or all of my teaching strategies that I developed it is not where I stand and prepare a lecture I used to when I first started here not anymore ( Participant A, I:37 ).*

This was noted during classroom observations that the lecture method was employed by some participants. The lecture method has been advocated for large classes, and when a lecturer wants to cover large content within a short time, but it has been heavily criticised for promoting passive teacher centre learning (Ramani, 2006). Sajjid (2010) stated that this method can be effective, provided the material is stimulating as well as thought provoking, namely by using examples to make it memorable, utilising effective visual aids and questioning throughout the lecture to make it interactive. The classroom observations added insight into the use of this method of teaching as the participants used visual aids. Participant B's lecture was more interactive than Participant C. The

use of the questioning technique resulted in most students responding simultaneously. This led to lively classroom discussions with students sharing information with each other or voicing their disagreements with incorrect answers. Allowing the students to respond simultaneously needs very strong classroom control because this can lead to chaos and distraction. In this classroom observation, the class was kept under control by the lecturer. All participants indicated that they employ group, and or individual presentations, as a teaching strategy. How this method was employed varied among the participants. Participant A's classroom activities were generally structured around individual presentations in combination with online activities. Participant A had very few students as compared to the other participants who employed mostly group presentations due to large class numbers. Presentations, either group and or individual as a teaching strategy, promote student participation and active learning as indicated by Russell et al., (2007). In group presentations there is sharing, exchange of information and ideas which encourages accountability, responsibility and visibility which are some of the features of SPs as indicated by Shulman (2013). In group presentations each member has a responsibility in ensuring that the group performs well, and there is no place to hide, as students are expected to take full responsibility for their actions (Musa et al., 2015). In a similar way individual presentations promote active learning as students take responsibility and accountability for all their actions and cannot afford to let the whole class down by not performing to the expected standard (Musa et al., 2015).

Assignments and projects, which may be done individually or as a group, were also a common teaching method employed by all participants. Assignments and projects enhance research skills, help students to research, organise and present information in a written and oral format (Sajjid, 2010). Assignments and projects also promote active student engagement in the acquisition of knowledge (Russell et al., 2007). Case studies were also employed by all participants. Case studies, as used by the participants, appeared to be very closely aligned to case-based learning; they are effective teaching strategies that promote active learning, problem solving and creative thinking skills, according to Ramani (2006).

Depending on the subjects they teach, and the availability of the simulation tools, most lecturers, employed in the radiography department, where this study was conducted, use them in practical teaching and assessment. By using simulation, students are initiated into equipment handling as well as performance of various radiography techniques and procedures without using radiation prior to their exposure to patients in clinical centres. Through simulation students start to think, perform and act in a professional manner which, according to Shulman (2013), is essentially what is expected in SPs of the profession. In addition simulation is important in reducing unnecessary ionising radiation exposure to patients and the public.

Although all participants employed a variety of teaching strategies, no distinctive SPs were identified. Elements of SPs were noted in teaching strategies that promoted active or participative teaching, and learning strategies such as self-directed independent learning, group or individual discussions, assignments, case studies, and independent learning combined with the blended approach. This indicates that even though these strategies are generic they can be developed into SPs for radiography education. This is in line with Shulman's statement "signature pedagogies of profession are both generic and highly domain and situation-specific" (Shulman, 2013). Other researchers, such as Jenkins (2012), and Meyer and Shannon (2010), investigated the use of generic teaching pedagogies as SPs in their fields. Jenkins in 2012 identified class discussion as the SP for undergraduate leadership education.

This further indicates that additional generic teaching and learning strategies such as demonstration, simulation and clinical education can be SPs in the context of radiography education. Clinical education in nursing has already been identified as SP thus the features and structure of clinical education in radiography fulfil the characteristics of SP as indicated by Shulman in 2005. Clinical education is part of every radiography education programme, both nationally and internationally. This is closely associated with clinical ward rounds which were identified by Shulman (2005) as the SP in the education of medical students.

In this study clinical education refers to work integrated learning (WIL), work place learning (WPL) and experiential learning. Clinical education was identified as the crucial aspect of radiography education. Since radiography is a skills-based profession, all the required skills and competencies have to be learnt in a clinical environment. Students are expected to demonstrate technical, clinical and professional skills, which can only be achieved within a clinical environment. Clinical education is as important as the academic theoretical component; it is where students are fully inducted into the profession, where they are taught to apply the theoretical knowledge in order to think, perform and act like professional radiographers. Clinical education is achieved by working in partnership with clinical centres, both private and public radiology departments. This is achieved through clinical coordinators, or tutors and all involved in the education of students including other radiographers and radiologists.

The alignment of theoretical professional knowledge and clinical education is aimed at ensuring that students are fully inducted into the profession. Students begin as novices without any professional knowledge or competencies and end as professionals whose habits of the mind, hands and heart have been changed. The development of habits of the mind, hearts and hands are the centre of Shulman's theory of SPs.

The next section covers a discussion of findings obtained from interviewing the clinical coordinators. They provide integration between the theory and practice and are responsible for clinical education.

#### 4.4.2 Clinical coordinators

The main goal of clinical education in the health care sector is to ensure that all practitioners are well prepared and capable of delivering high quality care which is essential to the health and safety of all patients under their care (Fortsch, 2007). Thus clinical education forms the major component in the education of healthcare practitioners. Radiography, as a profession, like other health professions such as nursing, physiotherapy, and occupational health, is a practice based profession. It has a major practical component that requires a mixture of pedagogical approaches that are geared to ensuring that graduates are able to integrate theoretical professional knowledge within a practical clinical environment, and can apply the knowledge in a

variety of circumstances and in different patient situations (Fortsch, 2007). In clinical education, students are exposed to real life situations, unlike in the academic simulated environment. Students work with clinical coordinators and other radiographers, both in private or public radiology services, and learn through observations, participation, reflection and the application of professional knowledge and skills.

Prior to establishing the teaching approaches or strategies, employed by the clinical coordinators who participated in this study, the clinical coordinators were asked to indicate their 'expectations' of newly qualified radiographers when joining their departments. Expectations in this context refer to the professional competencies and skills they expect newly qualified radiographers to have. Newly qualified radiographers are those who have recently graduated. In relation to healthcare professions, excluding nursing, this is at the beginning of community service, which usually starts in January of each year. Community service was implemented by the South Africa's National Department of Health in 1998 for doctors, and followed by the other health professions from 2000 onwards. The aim of community service is to improve healthcare services to all communities, especially in the rural areas. Additionally community service provides new graduates with the opportunity of professional growth and development (Reid, 2002). They get the platform to further develop and enhance their habits of the mind, hands and heart as required in the healthcare sector (Shulman 2005). Radiography education is geared towards ensuring that all graduates are capable of working competently with minimal or no supervision in their chosen discipline, from the onset i.e. post qualifying (Fortsch, 2007; Williams & Berry, 1999). In general terms they are expected to 'run with it'.

The interviewed clinical coordinators (n=7) were selected from the three disciplines of radiography: diagnostic radiography, nuclear medicine, radiotherapy. As the clinical coordinators comprised these three disciplines it should be noted that the term 'diagnostic imaging' is used in this study for imaging undertaken by diagnostic radiographers. There was general consensus amongst the participants, from the three disciplines, that all newly qualified radiographers should be clinically and technically competent in their discipline. Moreover, they should demonstrate an appropriate level of

professionalism and patient care. They should possess managerial or leadership skills, as well as health and safety skills specially related to the profession and radiation safety. Humane values were emphasised as very important by a number of participants, although others ranked clinical and technical competencies above these. Humane values are similar to soft skills and incorporate all the soft skills as mentioned previously under graduate attributes. The clinical coordinators 'expectations' of newly qualified radiographers were closely aligned to the exit level outcomes (ELOs) indicated in SAQA and HPCSA documents, as well as what the lecturers expected as graduate attributes.

The clinical coordinators were then asked to indicate the teaching strategies they employ to ensure that graduates would fulfil the expected outcomes. All participants affirmed that students rotate through different areas during the clinical education blocks. This is to ensure that the students are exposed to a variety of examinations and different procedures. The following are the comments from the interviews that confirm the expected outcomes of the clinical coordinators. Participant 10's comment was:

*When the students are trained they are taken through the various sections within the department, so that they can be clinically competent eventually in each one of those section (Participant 10, I: 58).*

In addition Participant 3 said

*Okay, well what we try and do is, we try and expose the students to as much variation in the clinical field as we possibly can. So here at this **venue** because of the nature of our practice, some of our venues will do, like **C** for example does a lot of injured on duty types of studies and also a lot of TB chest, asbestos type of things. So, when the students go there we know that they are going to be learning a lot of those kinds of diseases. Then again, when they go to other hospitals, like **P**, for example, where there are a lot of urologists, we know that they are going to learn a lot about the urinary system, so we try and rotate them through, as the needs arise through different venues, and we try and dovetail that to what they have learnt academically at DUT (Participant 3, I: 67).*

The academic institution provides clinical rotation rosters for all students from levels 1 to 3. These rosters indicate the various workstations, venues and hospitals and stipulate where students have to be allocated during clinical placements. The rosters are compiled by each level coordinator and sent in advance to the clinical coordinators and also given to individual students. Thus rotation during clinical education forms an integral part of clinical placement.

The identified teaching strategies employed by the clinical coordinators, during clinical education, range from those that were commonly used such as individual or group discussions, demonstrations, simulation, role playing, observation and scaffolding. The less commonly employed strategies were mentoring and role modelling.

The commonly employed teaching strategies are indicated in Table 4-3.

**Table 4-3.** Frequently employed teaching strategies

Teaching Strategy	Explanation
Individual / group discussions	Oral exchange between individual or group members and the instructor
Demonstration and observations	Teaching strategy based on the concept that to teach 'how' is to 'show how'
Simulation	Real life situations are artificially reproduced in order to achieve specific goals without compromising patient safety
Role playing, mentorship and role modelling	Students participate in activities where they act out specific roles
Teamwork	Students are actively engaged and expected to function as members of the team

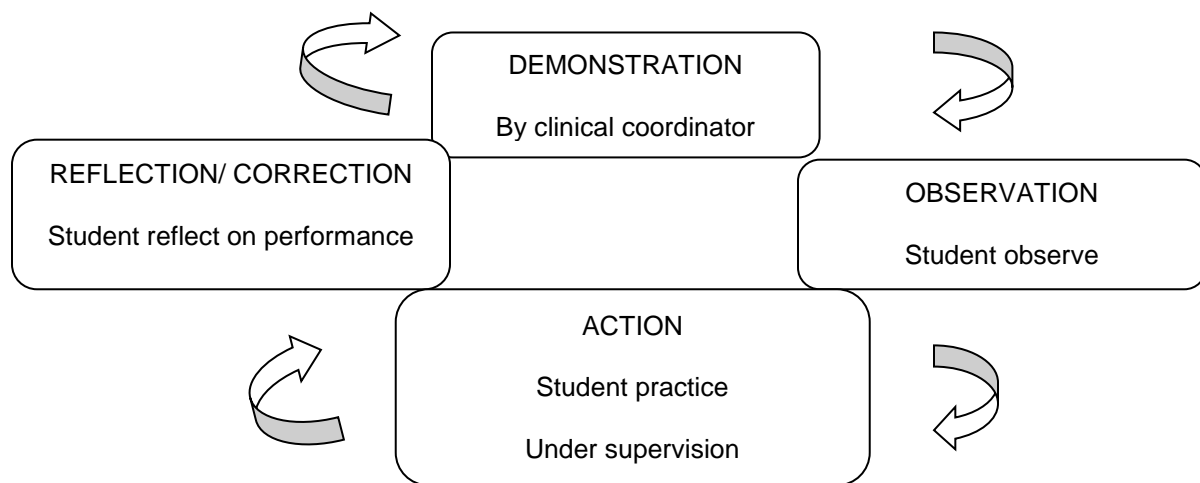
All interviewed participants indicated that they conduct individual or group discussion sessions with all the students to establish existing knowledge, based on the theoretical component that had been covered during the academic block. Once prior knowledge is established, it is followed by the teaching approach which is in line with the students' expected level of knowledge, as well as in relation to the availability of patients for the specific examinations. The demonstration approach was identified as the one pedagogy that is generally employed across all disciplines of radiography

Demonstration as a teaching pedagogy can be linked to Knapp's demonstration model. According to Knapp, "What a man hears, he will doubt. What a man sees, he may possibly doubt. But what he does himself, he cannot doubt." — Seaman A. Knapp the Father of Extension

Based on Knapp's model there are two types of demonstration techniques: results and method. These two techniques, when described in relation to radiography, differ in that in the first technique the emphasis is on the practical results, meaning a student practices under the supervision of a clinical coordinator. Whereas in the second technique, a clinical coordinator demonstrates the procedure and students observe how

the procedure is done before attempting to perform it. The demonstration technique, as applicable to radiography, is an interchange between the two techniques depending on the level of knowledge of the students. In addition, demonstration in clinical training centres differs vastly from the demonstrations as applied at academic institutions or other careers. The demonstration involves only one to a maximum of two students where patients are involved for patient privacy and confidentiality. All students are expected to always request a patient's permission prior to performing or observing any procedures. If a patient declines, the procedure is then conducted solely by the radiographer.

Teaching using the demonstration approach is demonstrated in Figure 1 and is closely aligned with Kolb's cycle of experiential learning.



**Figure1.** Demonstration teaching strategy

During demonstration, a clinical coordinator or radiographer provides an in-depth explanation of the procedure from the beginning to the end. The demonstration depends on the procedure being conducted and may involve patient care, communication, examination technique, equipment operation and manipulation and image evaluation especially in diagnostic imaging. A student observes and is allowed to ask relevant and pertinent questions. This is focused observation with the success of the demonstration depending on a student's power of observation. The student then performs the procedure under observation by the clinic coordinator who provides guidance and

corrective measures. Thereafter, the student is asked to reflect on his or her performance, identify the positives and weaknesses of the procedure and the corrective measures where applicable. In diagnostic imaging the reflection stage also includes the evaluation of the resultant images and image interpretation. The process is repeated until the student has achieved the required competency and has developed the self-confidence to proceed with minimal supervision as can be observed from Participant 1's comment:

*Demonstrating not once, not twice, a couple of times and gauging whether that student is grasping and whether they are confident. Then they try it out with you there. They are the participant in that examination and then they do it. You basically do not leave a student alone until you know they are confident (Participant 1, l: 176).*

The same participant had previously stated that radiography clinical education involves the following:

*if the student has not done it before in the department, the radiographer shows them not once, not twice, it can be ten times until the student says – the radiographer will ask the student, are you happy to do this now with me watching you, and as they are positioning the radiographer corrects them and ensures that they use the gonad protection, shows them positioning. So it is done while the patient is there on a one-to-one basis, positioning and directing the student. So it is basically observing, practicing in the presence of the radiographer. That's the only way radiography can be done (Participant 1, l: 121).*

In support of the demonstration, as a teaching strategy, Participant 7 stated:

*Yes, I go over everything with them; this is how I do this femur, if it is a femur; this is how I do my shoulder, if I am doing a shoulder, I demonstrate to them. Then after that I can let them also practice in my presence. I watch them until they are confident, they are okay with the views, then I can let them then practice on their own (Participant 7, l: 175).*

The demonstration teaching pedagogy is applied across all disciplines of radiography, as well as across all levels of student training, with strong application in first year, where all the basics of the profession are introduced and taught. In the second and third year programmes it is applied when new concepts and procedures are introduced. The process ranges from teaching simple to complex procedures. For example, from teaching students how to receive patients, review patient history, and how to perform complicated procedures such preparing and injecting radiopharmaceuticals.

Participant 1 was emphatic that learning occurs this way.

*When it comes to screening as well, the only way that the student will learn is the more you do and the more you observe. So they take the students in and say right from start to finish explain; this is how we set up the trolley, this is how we position the patient, this is what the radiologist expects. You do it a couple of times and when you know now, when you are watching the student, you can gauge whether they are actually confident, and then when you feel as a radiographer, right, this student can do this on their own, then you watch them in their presence, with the patient there, you watch if they are actually performing the task (Participant 1, l: 128).*

Some participants employed demonstration as the main teaching strategy, especially when teaching first year students. Demonstration, as a teaching strategy, enhances focused observation skills: it is habitual and routine, students know what to expect during clinical education. This calls for strong student participation resulting in students being accountable for their performances, visible with no place to hide. There are challenges during clinical education that students have to overcome, such as situations that are sometimes emotionally charged and unpredictable, but they have to make a decision instantly, 'on the go' when the patient's condition changes and the procedures need to be modified. Public performance, accountability, and active engagement, are some of the characteristic features of Shulman's (2005) SPs.

Others participants stated that when they teach first years they initially employ simulation and role playing, followed by letting the students work with patients while they observe, or watch and / or offer corrective measures. Role playing, in this context, is similar to the approach employed by Participant B in the academic institution. Namely, that in diagnostic radiography specifically, students are asked to position each other, set the appropriate technical factors for a specific X-ray procedure and evaluate each other's technique. Student does not complete the process to avoid unnecessary radiation exposure. Participant 2 underscores this as follows:

*I told you I start off by when they first start, I take them in two's and show them the positioning – make them position each other for the projections that they have already learnt at the Technikon. And from then on they must take patients and x-ray them with me supervising them. So I leave them to position themselves, I let them make mistakes but I never let them expose until we have corrected those mistakes,*

*and then let them expose, because otherwise they are going to doing an awful lot of repeats; some of them not all of them (Participant 2, l: 57).*

When evaluating Participant 2's teaching strategies, it became apparent that a combination of three different pedagogies was used. Initially this participant employed simulated demonstration, combined with role playing, which was finally followed by the students performing the examinations under supervision: a Type 1 demonstration technique.

Participant 10, who employs simulation, stated

*Initially they watch and they watch how the qualified radiographers actually do the preparation of the radiopharmaceuticals, and then we allow them to practice with non-radioactive products like saline, because the handling of a syringe in the wrong hands can be quite a challenge (Participant 10, l: 87).*

This participant employed Type 2 demonstration technique in a simulated situation. Based on the above comments it became apparent that demonstration is not only used where patients are involved, but also in simulated situations. All participants stated that clinical education is structured according to the educational level of students under their care. With first year students the emphasis is on teaching the basic concepts under strict supervision until they have been mastered them. From second year the specialised procedures are introduced in the programme. Third year programme involves independent practice of first and second year procedures, and learning advanced specialised procedures. Participant 10's view

*Here in this setup, in the clinical setup, we roster them through the different areas, so they would start in first year, watching, observing how it is done. We don't expect them to do it in first year, but they observe, so there would be days of the week where they would start in a hot lab setup and watch the pharmaceuticals being made up (Participant 10, l: 207).*

Participant 3 said

*So initially, when they first start and we know that they are going through the planes, and the 'how to handle a patient' and the psychodynamics and so on, we like to get them through their ward rotations, we like here in the department, to put them onto what we call 'admin and patient care' where they talk to the patients, they change the patients, they put the patients on the table, they help the wheelchair, they help to move them on trollies and so on. Then when they start going into the basics, say of the upper limb, we try and put them at venues which are our busiest venues, where they are going to get quite a lot of exposure to skeletal work (Participant 3, l: 77 ),*

and added

*In second year, where they now start looking at the variant studies and so on, we try and put them and roster them in the clinical so they now start going to the screening rooms and into fluoroscopy, where they are going to see what they are studying, they have a very good chance of seeing those examinations, again at all of the venues. But I like to alternate that still with the general work to try and keep them still up-to date, so they don't get stale with what they've learnt (Participant 3, I: 89 ).*

*And then in third year, I like to put them into CT. Right from day one, we put them into CT, but bear in mind that the size of the group can limit what we are actually exposing them to and how much exposure they get because they've still got to learn other things as well, so I like to put them through CT in third year because now, CT is no rocket science, any radiographer can do basic CT. Basic CT; when I talk basic CT – they can do a skull x-ray pre and post enhancement (Participant 3, I: 98).*

These statements further affirm the association of radiography education to the social constructivism learning theory, which has emphasis on knowledge acquisition rather than transmission through social interaction as discussed in Chapter Two. During clinical education, students are expected to construct their own meanings, utilise prior existing knowledge, learn through social interactions, and finally learn tasks in order to make the learning experience meaningful (Applefield et al., 2001). Meaningful learning is achieved when students learn under guidance of clinical coordinators and radiographers, as well as mentors within their zone of proximal development until they have successfully mastered and achieved basic to complex skills. The main goal in clinical education is to ensure that students reach their zone of actual development when they can perform tasks independently and are fully inducted into the profession.

According to the participants, the first year students begin with basic skills or tasks under supervision. When these have been mastered, more complex tasks are introduced, until the students reach their ZAD, where they are expected to work independently. This is known as the scaffolding teaching strategy, which is associated with Vygotsky's theory of development (Vygotsky, 1978).

The process of learning in stages was further supported by the participants. According to Participant 10, first year radiotherapy students are taught fundamental skills such as infection control, patient care, communication skills, and are introduced to patient positioning for the delivery of radiotherapy treatment procedures. This is further developed in second and third year when students are taught how to review patient

treatment folders, work in the simulation section, followed by treatment planning, calculation of radiation dose, and the delivery of radiation treatment at third year.

Participant 4 indicated that first year diagnostic radiography students are also taught infection control procedures, patient care, patient communication, and general skeletal radiography techniques. The progression to second year involves the introduction of specialised radiography procedures such as fluoroscopy, critical care radiography, and ward radiography. By third year the students are expected to be competent in all first and second year skills and additional specialised procedures: multiple trauma radiography, computed tomography (CT), magnetic resonance imaging (MRI), mammography, and paediatric radiography are introduced.

According to the clinical coordinators the students are taught in stages. They have to be competent in all the skills required for each specific level before progressing to the next level. Clinical assessments are conducted to establish whether the students have successfully achieved the competencies as specified in their study guides and clinical manuals. When the lecturers and clinical coordinators were asked whether their teaching and learning strategies were unique to radiography, the general response was that the context in how these strategies are employed in radiography education makes them unique and specific to the profession. The majority agreed that clinical education, demonstration and simulation, and how these are employed in student education, are very specific to the profession.

## 4.5 IDENTIFIED SIGNATURE PEDAGOGIES

### 4.5.1 Clinical education

The commonly employed teaching and learning strategies that were identified included clinical education, simulations, demonstrations, online and offline class discussions, and the traditional lecture method. The findings of the analysed data indicated that clinical education is the SP in radiography education. Aspects of SPs were also identified in simulation pedagogies, as well as in classroom discussions. Clinical education was identified as the primary SP. The demonstration approach, in clinical education, was identified as the secondary SP. This was established by the role of clinical education in developing the following habits. The habits of the mind, which is cognitive

apprenticeship, the habits of the hand, which is the practical apprenticeship, and the habits of the heart, which deals with the moral dimension and professional behaviour and ethics. The other aspects of clinical education that were examined include features of engagement, uncertainty, formation, pervasiveness and routine. Clinical education is structured to engage students in learning how to think, act and behave like professional radiographers. This, according to Shulman (2005), is how professions prepare their students for the profession ensuring that a novice is fully inducted into the profession.

Clinical education can be regarded as pervasive because it is an accepted and required part of radiography education worldwide. Internationally, universities that offer radiography education, especially in countries such as the United Kingdom, Australia and New Zealand, have a structured clinical component which is almost similar to South Africa. Variations however occur across different countries and among academic institutions nationally, but there are very strong similarities on how clinical education is conducted according to email correspondence from a senior academic from Australia dated 7 May 2015. In South Africa, radiography students are expected to accumulate 2500 clinical hours during their training. In Australia students do not have stipulated hours but each radiography programme is required to demonstrate how the students have obtained clinical training (Baird, 2015). Furthermore, the students are also required to spend one year of clinical placement if they have not studied the four year programme before they can be registered with the Medical Radiation Practitioners Board of Australia (MRPBA) which is the regulatory board. The four year degree programme at Charles Stuart University stipulates that students spend a total 62 weeks in clinical placement, which is spread across the four years, with maximum weeks at the fourth year, according to an email dated 9 July 2015 from the Course Director: School of Dentistry & Health Science .

In South Africa all radiography education programmes are regulated by the HPCSA. Clinical education is only conducted in HPCSA accredited clinical training facilities. At the institution, where this study was conducted, the rules of engagement are clearly defined. Clinical education is structured in blocks, which range from three to eight weeks, and is assigned a total of 70 weeks over a three year period. Sixty weeks are

allocated to the academic theory blocks. The students are allocated to various HPCSA accredited clinical training centres that have assigned clinical coordinators and radiographers to teach and supervise them. Students are informed in advance about clinical rotations to various hospitals in Durban and Pietermaritzburg. There is a structured policy for clinical education. The radiography department provides clinical rotation rosters, logbooks, clinical manuals, code of conduct booklets and time sheets booklets.

The main teaching strategy employed by a majority of clinical coordinators, according to interview findings, is demonstration pedagogy. Clinical coordinators did not have 'shared views' of how best to teach and impart the knowledge to students. Moreover, variations exist in terms of resources such as equipment and staff between the public and private radiology departments. Private radiology departments are equipped with the latest advanced medical equipment, have better staff ratios and better working environment as compared to the radiology services in the public sector. In terms of latest technology, especially in diagnostic radiography, all private radiology departments are equipped with digital radiology systems whereas only a few departments within the public sector have gone digital.

Although clinical education is regarded as pervasive, routine and the rules of engagement are well defined, there is however a degree of uncertainty especially when students embark on their first clinical exposure after spending weeks to months in an academic environment. They suddenly face a totally different environment or a reality that they do not fully comprehend. They might have done preclinical simulated laboratory work in preparation for the clinical education, but when faced with reality, anxiety levels increase. They may find themselves faced with multiple trauma patients, difficult non-complying patients, and impatient harassed clinical supervisors. Working with healthy models who are peers and mannequins, in the simulated laboratory settings, differs vastly from a clinical environment, in which sick patients are involved. Students have to deal, not only with communicating with the patients under their care, but also with disgruntled family members and impatient referring doctors who expect results 'as in yesterday' (Fortsch, 2007). In some situations the students are faced with

incongruences between the theoretical knowledge, simulated laboratory work, and real life working environment. Additionally there is also a level of uncertainty related to changes in clinical rotations, new hospitals or departments. The students may be apprehensive about how they will be received in the new department and be concerned about the working environment. Shulman (2005) stated that acceptable levels of anxiety are important as they ensure that students are always vigilant about their work and performance. He further defines this as the pedagogy of uncertainty.

Shulman's habits of the mind, hands and heart are similar to Bloom's taxonomy of cognitive, psychomotor and affective domains (Krathwohl, 2002). These are generally known as knowledge, skills and attitudes. During clinical education, students are expected to combine all three for effective patient management. To achieve the required competencies students have to apply the propositional, acquaintance and procedural knowledge they obtained in the classroom to a variety of situations ranging from basic to complex tasks in keeping with standards of the profession. According to Participant 3 basic knowledge is essential.

*So, for me, if they can do good – have a very good understanding of basic radiographic techniques and basic radiation sciences, and radiation protection, and all of those things, I think that they can then have a very good foundation to learn the more difficult stuff (Participant 3, I: 28).*

The above mentioned forms of knowledge are obtained in the classroom and have to be applied and further developed in practice. Knowledge of radiographic techniques is taught in procedural knowledge. Radiation sciences and radiation protection are subjects taught in propositional knowledge. Clinical education involves active student engagement, which is demonstrated from the onset when they perform fundamental procedures such as infection control, reviewing of patient history, patient care and communication. Active student engagement is part of the demonstration teaching approach whether the students are engaged as in Type 1 or Type 2 demonstration. Students are always visible in the department since they are involved in the preparation of procedure rooms prior to receiving patients, verification of patient details, reviewing of medical history, performing the requested procedures, evaluating the resultant images in diagnostic imaging procedures, and discharging the patients after the

procedures. Clinical coordinators and radiographers are constantly present or within reach to provide the necessary guidance and corrective measures.

All participants in the study indicated that students work under supervision. The level of supervision ranges from extreme 'practically breathing' down the students' necks to minimal supervision as they become more competent. Not only are students visible, but are also accountable to: the patients under their care, peers when working in pairs, the clinical coordinators or people supervising them. Furthermore they are under the spotlight of the patients, other healthcare professionals, and sometimes immediate family members. Pedagogy of engagement is another feature of SPs as described by Shulman (2006), and is linked with the development of habits of the hands. It is associated with public performance; being under the spotlight involves accountability and can be anxiety laden.

Soft, or humane skills, emerged as essential skills when the curriculum documents were analysed, and also in interview transcripts of both lecturers. During clinical education, students are expected to demonstrate appropriate levels of soft skills when dealing with patients, members of the public and colleagues. Dealing with sick people involves demonstration of professionalism, and appropriate patient care skills encouraging the patient until the patient is discharged from a radiographer's care. During clinical education students have to be taught and shown appropriate professional behaviour practices. These are also reinforced throughout their years of training. Concern was raised by a few clinical coordinators on the lack of appropriate soft skills demonstrated by some students as indicated from the comment below.

*And they want to get that over and done with as quickly as possible, because they don't really like touching the patients; they don't like giving the patients a bed pan; they don't like the blood and the guts and the dirt and the cleaning up and everything else that goes with the profession, and the nurturing. You see them when they are holding a patient, you know 'am I going to get AIDS from this patient, this patient is dirty', you know 'what are they contaminating me with' (Participant 2, I: 208).*

Participant 2 added

*Every single day, I watch them. If they don't help their patients off the table, I make them help their patients off the table. If they don't clean and tidy the room when they are finished, I make them do it, because nobody wants to go into a dirty room or with a pillow half on the floor or scrunched up because somebody else has lain on it, and they all look at me as though I'm mad. You know, cleaning a cassette, if you've got blood on it, all those kind of things. That kind of thing I am very, very particular about. They have got to understand their patients are not things; they are human beings with feelings. And all you can do is nag them, you've just got to continually tell them and make sure that they do it (Participant 2, I: 85).*

To develop appropriate humane skills, students need continuous reinforcement and strict monitoring. Poor patient care, interpersonal skills, professionalism and lack of empathy, demonstrated by some students, were highlighted as challenges facing not only clinical education but the profession as a whole. Measures are currently being investigated on how to improve this challenging dilemma.

Major aspects of Shulman's SPs' criteria were identified in clinical education. This further asserts clinical education as the SP in radiography education. The criteria that were fulfilled included pervasive, it is practiced worldwide, routine with defined rules of engagement, pedagogy of uncertainty, pedagogy of engagement and pedagogy of formation. Based on this, clinical education is geared towards the development of habits of the mind, hands and heart.

#### 4.5.2 Demonstration

The demonstration teaching and learning approach employed by clinical coordinators was identified as the second SP. It addresses some aspect of Shulman's criteria, and it needs further development and research. Demonstration is pervasive within the curriculum and threads through from first year to third year. When clinical coordinators were interviewed, the majority employed the demonstration method. As mentioned previously there were no 'shared views' on how best to impart knowledge and skills to the students. Some clinical coordinators did not indicate their specific teaching strategies, other than stating that they allocate students to various work stations in the department.

Demonstration allows for active student engagement, public performance, and accountability, collaborative work with peers or supervisors. It can also be emotionally

rich or challenging depending on the patient situation. This further fulfils other additional characteristic features of Shulman's criterion for SPs. Demonstration pedagogy is employed as part of teaching clinical education and thus forms part of clinical education.

#### 4.6 CONCLUSION

This chapter presented the findings of the collected data, analysis thereof, and the findings of the study. The impact of the study findings in relation to the research questions are presented and discussed in detail in the next chapter. The data collection process included document analysis, which involved reviewing of the curriculum documents and study guides, individual interviews, and classroom observations.

The analysis of the curriculum documents revealed that the radiography profession, like other healthcare professions, has a major practical skills component. This was further observed when the interview transcripts of both the lecturers and clinical coordinators were analysed. The emerged categories obtained from the curriculum document, the exit level outcomes, the lecturers' graduate attributes, and the clinical coordinators, were all closely aligned. They all demonstrated that professional knowledge was important, and that clinical skills, technical skills, humane skills and professionalism were just as vital in the development of a professional radiographer. Professional knowledge is associated with cognitive skills, and development of habits of the mind. Clinical and technical skills are those which are associated with the habits of the hands; humane skills, or soft skills, are associated with the habits of the heart (Shulman, 2005).

When the data obtained from the study guides, lecturers' interview transcripts, and classroom observations, were analysed, clinical education emerged as the major education component that is necessary in the induction of students to the radiography profession. The teaching and learning strategies that were identified included the lecture method, self-directed learning independent learning, blended learning approach, individual presentations, innovative assessments, role modelling, demonstration, storytelling, simulation, edutainment, worksheets, self-study, active participative teaching, group activities and collaborative engaging learning. These are important to ensure that theoretical professional knowledge is well taught to students. Professional knowledge provides the knowledge that students are expected to apply during clinical

education thus integrating the theory to practice. The analysis of the utilised teaching and learning strategies, employed by the lecturers, did show elements of SPs and need to be developed further.

The analysis of the clinical coordinators' interview transcripts asserted that clinical education, simulation, and demonstrations, were imperative clinical teaching strategies. One participant stated that "*So demonstration is the way that radiography is done*". Although simulation has a strong association with aviation it has been widely employed in medical and allied healthcare professions in the development of a trainee's skills without compromising patient safety (Lateef, 2010). Clinical education integrates theory to practice and ensure that students are well inducted to the profession. Demonstration in radiography employs Knapp's Type 1 and 2 alternatively depending on the level of a student's development.

The next chapter concludes the study findings, and discusses the impact of findings in relation to the research questions and the limitations of the study.

1. What are the current teaching and learning strategies used most frequently by the lecturers in the radiography programmes?
2. What strategies can be identified as signature pedagogies for radiography?

## CHAPTER FIVE: STUDY CONCLUSION

### 5.1 INTRODUCTION

The focus of this research was to explore the teaching and learning strategies employed by lecturers, involved in radiography programmes, and to identify the existence of signature pedagogies in their teaching strategies. The previous chapter focused on the analysis and presentation of the research findings. How the research findings address the objectives, as well as the limitations of the study, are discussed in this chapter.

### 5.2 THE FREQUENTLY EMPLOYED TEACHING STRATEGIES

Analysis of the study guides, interview transcripts, and classroom observation, revealed a diverse number of teaching and learning strategies employed by both the lecturers and clinical coordinators in the education of radiography students. The frequently employed teaching and learning strategies by lecturers that were identified included the blended learning approach, online and offline class discussions, individual discussion, edutainment, role modeling, role playing, mentorship, the traditional lecture method, simulations, demonstrations, and clinical education. They also employed various innovative assessments strategies such as video production, online activities, which included students creating their own blogs for class discussions which carry marks. In most situations not all of these teaching strategies were employed in the preparation of students. All participants agreed that clinical education forms the basis of radiography education. They further attested that no graduate can develop the required professional competencies without clinical education. The established teaching and learning strategies were further analysed. The findings were classified into three groups: no significant indicators of SPs, elements of SPs identified, and definitely strong SP.

The lecture method, as a teaching strategy, was not used by all participants. Those that used it differed on how it was employed in their classrooms. One used questioning, storytelling and edutainment during the lectures. Another participant used discussions and included online activities during the lectures. The lecture method has been heavily criticised for promoting passive learning. Although the lecturers used various activities to enhance their lectures, no significant features of SP were demonstrated for this teaching method to be classified as SP in radiography education.

Variations were also observed on how the teaching and learning strategies were utilised. Some used the blended learning approach, with approximately more than 50% of their teaching activities online via e-learning (Blackboard). One participant only used social media such as 'WhatsApp' to communicate with the students. The use of technology, as a teaching strategy, is aimed at meeting the technology challenges of the 21<sup>st</sup> century. These were indicated as one of the challenges facing radiography education globally as discussed in Chapter One.

The blended learning approach enables students to take control of their work, and it has been shown to promote and enhance active student engagement through online discussion groups and blogs, enhance research skills and reflective skills. The blended learning approach incorporates characteristics of SPs such as accountability and responsibility; students are made visible through class or group discussions, blogs, and journaling. In this approach the lecturer facilitates, rather than lectures. This was noted during classroom observations. The study findings indicate that the blended learning approach has strong elements of SPs. The radiography department may benefit from spreading its use among all the lecturers. As mentioned previously, the institution aims to have all academic activities largely online using e-learning tool Blackboard (now referred to as the Think Learn Zone). The radiography educations may consider developing this generic teaching approach as a SP for radiography.

Other teaching strategies that displayed strong elements of SPs were online and off line group or class discussions employed by all participants in varying degrees. These involved student engagement in line with the characteristics of SPs. In addition to class discussions, the participants also employed individual presentations. Individual presentations are very effective in a small class as noted during classroom observations. Moreover they have strong elements of SPs. Due to limited simulation tools in the department, where the study was conducted, simulation pedagogy combined with demonstration was employed by one participant for preclinical student preparation. This was done by utilising various simulation tools such mannequins and skeletons. Simulation pedagogy, coupled with demonstration, involves student

participation. It has SP characteristic features such as visibility, accountability, and active student engagement.

Among the various teaching strategies employed by the lecturers there was no distinct SPs. Group or individual discussions, whether online or offline, have strong elements of SPs and need further exploration. The reason is that these pedagogies have been shown to promote and enhance student participation, critical and reflective skills, which were identified as lacking or a challenge in current graduates as mentioned in Chapters One and Two. The hallmark of SPs is that if they are effectively employed they can be successful in fully inducting novices into the profession resulting in graduates who can think, act, and perform with integrity.

### 5.3 IDENTIFIED SIGNATURE PEDAGOGY

All participants in this study were in agreement that clinical education is the foundational practice in radiography education. It was examined by the researcher and characteristic elements of SPs were identified. The main aim of clinical education is the integration of theory to practice. Clinical education was further noted to be pervasive, routine, and involved active student engagement. It is structured to develop habits of the mind, hands and heart thus satisfying Shulman's criterion of SPs. In addition clinical education can be classified as the pedagogy of uncertainty, engagement and formation.

The demonstration approach is essentially how radiography is taught to students during clinical education. However, due to the lack of consensus among the clinical coordinators, this teaching strategy could not be advocated as the main SP. In the clinical environment the demonstration approach was identified as the secondary SP. There was no consensus among the clinical coordinators on the use of demonstration as a teaching strategy, which presented a challenge. Based on the interview transcripts there were participants who emphatically stated that demonstration, whether Type 1 or 2, is how radiography is taught. Some, however, did not specify their teaching strategies but only highlighted rotations through various workstations as their teaching strategy. They all however identified rotations through various workstations as a strategy they used.

## 5.4 IMPORTANCE OF THE FINDINGS IN RADIOGRAPHY EDUCATION

The landscape of the radiography profession is dynamic and is forever changing. Advances in technology, and patient expectations add to professional responsibilities. This in turn requires critical thinker, reflective radiographers who take their education beyond the classroom to the real world. Promoting lifelong learning is necessary in the profession. SPs by their characteristics should be geared towards the fulfilment of the profession's requirements.

Simulation pedagogy is accepted in nursing education as a SP. It has the features of SP such as being pervasive, routine and with active student participation. It should therefore be utilised as SP in radiography education (Gurung et al., 2009). Simulating tools are very important when patient safety is of concern and issues of litigation become a reality. It is important to mention that the radiography department, where the current study was conducted, would benefit from purchasing additional simulating tools that can be employed for the education of all radiography students. Currently most simulating tools are utilised in the education of the diagnostic radiography students. There are limited tools for the other programmes such as ultrasound, radiotherapy and nuclear medicine. The reality is that resource constraints may limit the purchase of all simulating tools due to their exorbitant cost.

Elements of SPs were noted and identified in the demonstration pedagogy. These need further exploration involving a large number of participants in future studies. As indicated by some of the participants, the demonstration pedagogy is how radiography is taught and skills are transferred to students.

## 5.5 LIMITATIONS OF THE STUDY

The findings of the study could have been stronger if participation had been extended to the students, and radiographers, from various departments, who also work closely with students when the clinical coordinators are engaged elsewhere. As stated in Chapter Two, radiography education in the early years was similar to occupational therapy, as it enjoyed relational pedagogy. The large number of students, combined with the move from hospital base training to academic institutions resulted in the complex multi-relational pedagogy which includes clinical coordinators, as well as other radiographers,

radiologists, oncologists and obstetricians, for example. It is important to indicate that it was neither feasible nor practical to include all other role-players. Their input would have strongly enhanced the study findings. The students would have aided in establishing the effectiveness of clinical education, demonstration and simulation in their education. Observation at clinical sites may have been a challenge within the scale and time span of this study, but if done would have enhanced the study findings. Especially since clinical education emerged as the SP in radiography education.

Clinical education, as the cornerstone of radiography education, has to be effective in ensuring that students are well inducted and well prepared for the profession. Put differently, on graduation they should possess the necessary expected competencies according to professional standards. Variations were identified among the various clinical centres ranging from unequal resources such as latest technology medical equipment that is generally found in private radiology practices, while staff shortages impacted on the role of clinical coordinators. There is currently a study underway which is aimed at identifying and implementing a training model that will be used across all accredited clinical training centres in KZN. This will hopefully address and reduce the challenges and gaps in this study. More specifically those related to the effectiveness of the teaching and assessments strategies.

The findings of this study cannot be used for generalisation since it only focused on one university among eight that offer radiography education programmes. As a case study it can still be used for further research as a multiple case study nationally thus ensuring it meets the criterion for generalisation. Another key point that needs to be emphasised is that all radiography education programmes nationally have, or are in the process of, shifting from three year national diplomas to four year professional degrees. The teaching strategies are reevaluated in the line of these changes. It is important to point out that clinical education is notably still a major component in the new structure.

Participation in the study was voluntary. This meant that there were clinical coordinators who chose not to participate. One could argue that if they had participated their responses may have added value to the outcome and findings of this study. The inclusion of the students may also have added to the richness of the collected data. The

possibility of increasing the sample size and using questionnaires in the data collection was considered, however the use of interviews enabled the researcher to unearth issues that did not directly relate to the study but had impact on the quality of students' education. Some of these issues have been dealt with already.

When the study was conducted the department had a permanent academic staff complement of seven lecturers including the researcher, two were in the pilot study, three were participants and one was newly employed. The latter did not meet the selection criteria. Having more academic participants may have added value. Classroom observations spread over a longer time frame, rather than one period session per participant, would have benefited the study since teaching strategies are sometimes influenced by the topic that is being presented.

Signature pedagogy, as a theory, proved to be challenging for a novice researcher. There are different interpretations and understandings of this theory and its conceptual framework. Although email correspondence was initiated with Professor Shulman, this did not fully clarify all aspects of the theory. As mentioned previously he posted on his Blog that researchers started working on his theory while it was still developing.

## 5.6 CONCLUSION

The purpose of the study was to identify the teaching and learning strategies that are frequently employed by the lecturers in the radiography programmes, and to identify existing signature pedagogies.

Clinical education fulfilled Shulman's characteristic features of signature pedagogies: routine, pervasive, accountability, public performance, participative student engagement. It also demonstrated three distinctive characteristics, namely, pedagogy of uncertainty, engagement, and formation. Furthermore these are aligned with Shulman's view on the development of habits of the mind, hands and heart. Otherwise referred to as teaching the students to think, act and perform with integrity. Clinical education in this study emerged as the SP in radiography education. Simulation, demonstration, group and individual discussion all demonstrated some elements of SPs. They however warrant further evaluation to verify them as SPs in radiography education.

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## APPENDICES

## Appendix A: Interview Questions

### LECTURERS

What are the core graduate attributes that are expected from the radiography students who successfully complete their qualification?

What are teaching and learning strategies do you employ in your classrooms that ensure that these graduate attributes are achieved?

Can you identify any strategies you think are specific to radiography?

**PROMPT QUESTIONS.** These will be used for clarity where necessary in order to obtain full descriptive answers or responses.

### LECTURES

In response to the first questions – Are these graduate attributes specific to radiography?

Prompt question in response to the last question - Can you explain this?

### CLINICAL COORDINATORS

What are your expectations of the newly qualified Radiographers in your department?

What clinical teaching strategies are you currently employing in your department which ensures that the radiography students achieve the expected outcomes?

Are these clinical teaching strategies uniquely specific to radiography?

**PROMPT QUESTIONS.** These will be used for clarity where necessary in order to obtain full descriptive answers or responses.

### CLINICAL COORDINATORS

Prompt question in response to the second question.

Can you please explain why the clinical strategies are unique to radiography?

## Appendix B: Observation Checklist

Name/ Code of Participant: \_\_\_\_\_ Date of Classroom Observation: \_\_\_\_\_

Class Level: (e.g. First Year) \_\_\_\_\_ Number of Students in the Classroom: \_\_\_\_\_

Teaching Method	Used – Yes; not used No		Observation Comments
Lecture			
Interactive Lecture/ Discussion			
Small Group Discussion			
Individual Presentation			
Group presentations			
Role Play Activities			
Seminars			
Brainstorming			
Case Study			
Story / Storytelling			
Research Projects and Presentations			
Simulation			
Reflective Journals			
Demonstration			
Media Clips			
Online Activities			
Worksheet Activities			
Role Modelling			
Peer teaching			
Quizzes			
Other Edutainment			

## Appendix C: Ethics Clearance



21 November 2013

Ms Zambiso Cynthia Dlodla 971158069  
School of Education  
Edgewood Campus

Dear Ms Dlodla

Protocol reference number: MSS/1265/013M  
Project title: Exploring Signature Pedagogies in Radiography Education at a Higher Education Institution in KwaZulu-Natal.

### Provisional Approval - Expedited

This letter serves to notify you that your application in connection with the above has been approved, subject to necessary gatekeeper permissions being obtained.

This approval is granted provisionally and the final approval for this project will be given once the above condition has been met. Please quote the above reference number for all queries/correspondence relating to this study.

Kindly submit your response to the Chair: Dr S Singh % Prem Mohun, Research Office as soon as possible

Yours faithfully

Dr Shonuka Singh (Chair)  
Humanities & Social Science Research Ethics Committee

/pm

cc Supervisor: Ms R. Searle  
cc Academic Leader: Dr MN Davies  
cc School Admin: Mr Thabo Mkhembu

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Humanities & Social Sciences Research Ethics Committee

Dr Shonuka Singh (Acting Chair)

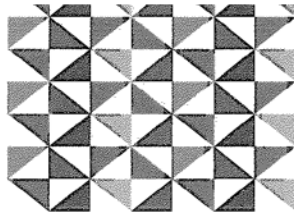
Westville Campus, Gervan Nkomo Building

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Website: [www.ukzn.ac.za](http://www.ukzn.ac.za)

## Appendix D: Permission to Conduct Research at DUT



*Directorate for Research and Postgraduate Support  
Durban University of Technology  
Tromso Annexe, Steve Biko Campus  
P.O. Box 1334, Durban 4000  
Tel.: 031-3732576/7  
Fax: 031-3732946  
E-mail: [moyos@dut.ac.za](mailto:moyos@dut.ac.za)*

10<sup>th</sup> December 2013

Ms Zombuso Cynthia Dladla  
c/o College of Humanities  
University of KwaZulu-Natal

Dear Ms Dladla

### **PERMISSION TO CONDUCT RESEARCH AT THE DUT**

Your email correspondence in respect of the above refers. I am pleased to inform you that the Institutional Research Committee (IRC) has granted permission for you to conduct your research at the Durban University of Technology.

We would be grateful if a summary of your key research findings can be submitted to the IRC on completion of your studies.

Kindest regards.  
Yours sincerely

A handwritten signature in black ink, appearing to read 'S. Moyo', written over a horizontal line.

**PROF. S. MOYO**  
**DIRECTOR: RESEARCH AND POSTGRADUATE SUPPORT**

## Appendix E: Department of Health



**health**

Department:  
Health  
**PROVINCE OF KWAZULU-NATAL**

**Health Research & Knowledge Management sub-component**  
10 – 103 Natalia Building, 330 Langalibalele Street  
Private Bag x9051  
Pietermaritzburg  
3200  
Tel.: 033 – 3953189  
Fax.: 033 – 394 3782  
Email: [hrkm@kznhealth.gov.za](mailto:hrkm@kznhealth.gov.za)  
[www.kznhealth.gov.za](http://www.kznhealth.gov.za)

**Reference : HRKM324 /13**  
**Enquiries: Mrs G Khumalo**  
**Telephone: 033 – 395 3189**

04 December 2013

Dear Ms Z C Dludla

**Subject: Approval of a Research Proposal**

1. The research proposal titled '**EXPLORING SIGNATURE PEDAGOGIES IN RADIOGRAPHY EDUCATION AT A HIGHER EDUCATION INSTITUTION IN KWAZULU-NATAL**' was reviewed by the KwaZulu-Natal Department of Health.

The proposal is hereby **approved** for research to be undertaken at **King Edward VIII, Addington, R K Khan, Prince Mshiyeni Memorial & Inkosi Albert Luthuli Central Hospitals.**

2. You are requested to take note of the following:
  - a. Make the necessary arrangement with the identified facility before commencing with your research project.
  - b. Provide an interim progress report and final report (electronic and hard copies) when your research is complete.
3. Your final report must be posted to **HEALTH RESEARCH AND KNOWLEDGE MANAGEMENT, 10-102, PRIVATE BAG X9051, PIETERMARITZBURG, 3200** and e-mail an electronic copy to [hrkm@kznhealth.gov.za](mailto:hrkm@kznhealth.gov.za)

For any additional information please contact Mrs G Khumalo on 033-395 3189.

Yours Sincerely

  
\_\_\_\_\_  
**Dr. E Lutge**

**Chairperson, KwaZulu-Natal Health Research Committee**

**Date: 04/12/2013**

uMnyango Wezempilo . Departement van Gesondheid

*Fighting Disease, Fighting Poverty, Giving Hope*

## Appendix F: Informed Consent

### INFORMED CONSENT FORM

College of Humanities  
Faculty of Education  
University of KwaZulu-Natal  
Pietermaritzburg  
3200

Dear Participant

I am a Masters student in Higher Education, in the School of Education at the University of KwaZulu-Natal and my study is related to teaching and learning strategies in Radiography Education.

You are invited to participate in this study, and data will be collected by individual interviews and where appropriate classroom observations. The sessions will be audio recorded. The process will take approximately 45 minutes and will be conducted at your place of employment. Your participation in this research is entirely voluntary and you may choose to withdraw at any time without repercussions. All responses will be treated in a confidential manner, individuals identity and their institutions will be anonymised as far as possible.

Your input is extremely valued and your time much appreciated.

Thank you

**Researcher**

Zombuso Cynthia Dlodla

88 Mountain Rise

Glenmore

Durban

Contact: tel: 0825935772

Email: [zombusod@dut.ac.za](mailto:zombusod@dut.ac.za)

**Supervisor:**

Dr. Ruth Searle

College of Humanities

Faculty of Education

University of KwaZulu-Natal. Pietermaritzburg 3200

Contact: tel: 033 260 6250

Email: [Searle@ukzn.ac.za](mailto:Searle@ukzn.ac.za)

## Appendix G: Declaration

I ..... (full names of participant) hereby confirm that I understand the contents of this document and the nature of the research project. I consent to participating in the research project.

I hereby consent / do not consent to have this interview recorded.

I understand that I am at liberty to withdraw from the project at any time, should I so desire.

SIGNATURE OF PARTICIPANT

DATE

.....