USING THE DELPHI TECHNIQUE TO DEFINE THE CLINICAL COMPETENCIES REQUIRED BY NEWLY QUALIFIED DIAGNOSTIC RADIOGRAPHERS IN SOUTH AFRICA

by

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I, Florence Elizabeth Davidson, hereby declare that this thesis represents my own work.

Signature: .....

Dedication

All praise to God for giving me the strength and wisdom to complete this thesis.

For Rob, Kim, Chelsey, my mom and dad,

with love and thanks.

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Abstract

Purpose: This research was performed to obtain consensus of opinion on the clinical competencies required of newly qualified diagnostic radiographers in South Africa in an attempt to improve alignment between educational practices, assessment practices and workplace requirements.

Methods: The Delphi technique, an effective group communication process was employed to recruit a panel of experts representing the radiography profession in South Africa. Three rounds of structured questionnaires together with controlled feedback were sent to the panel members for comment. The same four point Likert scale was employed in all three rounds of the questionnaire. Consensus of opinion was pre-determined at >75% agreement for each clinical competency.

Results: Response rates for rounds 1, 2 and 3 were: 84% (*n=49)*, 78% (*n*=45) and 69% (n = 40) respectively. Of the 109 clinical competencies listed in the first round questionnaire, 94 (86%) achieved consensus as being necessary clinical competencies required of newly qualified diagnostic radiographers. The remainders were further investigated in terms of whether they should be excluded or included in role extension possibilities. An additional 22 clinical competencies were also suggested by the panel in round 1 and further developed in subsequent rounds. The Mann-Whitney U test was used to test if there were any statistically significant differences in the opinions of academics and clinical practitioners as well as clinical practitioners from state and private practice. Statistically significant differences were seen when $p<0.05$. There were no statistically significant differences in opinions between clinical practitioners

from the various clinical platforms; however statistically significant differences were seen between academics and clinical practitioners. An analysis of these differences revealed that academics place greater emphasis on the Critical Cross-Field Outcomes and higher order cognitive competencies. There was divergent opinion on the clinical competencies incorporating aspects of role extension and academics were generally more supportive of role extension possibilities than the clinical practitioners.

Conclusions: The clinical competency requirements compare well with international standards of clinical proficiency of newly qualified radiographers; however it would appear that South African radiographers are lagging behind their UK counterparts in respect of role extension. A further forum for collaboration needs to be established to explore the differences in opinions between academics and clinical practitioners in an attempt to improve alignment between education, clinical assessment practices and workplace preparedness.

Acronyms and abbreviations

CCFO	Critical Cross Field Outcome
ETQA	Education and Training Quality Assurers
HCP	Health Care Professional
HEI	Higher Educational Institution
HPCSA	Health Professions Council of South Africa
NAP	New Academic Policy
NQF	National Qualifications Framework
SAQA	South African Qualifications Authority
SETAs	Sector Education Training Authorities
SGB	Standards Generating Body

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CHAPTER 1

THE RADIOGRAPHY CURRICULUM: CONTEXT AND BACKGROUND

> It was Victor Hugo who once said that there were few things more powerful in this world than an idea when its time has come. Today, in the world of the social sciences, one of the ideas whose time seems to have come is that of competence-based education and training. Competence-based education and training is an appealing concept. It is appealing because its aim is to delineate, in explicit terms, the competencies an individual should have at the completion of an educational course (Rosinski, 1975). In other words, competence-based training involves deciding the competencies which the butcher, the baker, the candlestick maker, must have in order to do their jobs and then designing an educational programme to ensure that they possess these competencies (Dunn, Hamilton & Harden, 1985: 15).

1.1 Introduction

The education of radiography students in South Africa is very closely linked with clinical practice as student radiographers are simultaneously exposed to academia and the workplace (Engel-Hills, Garraway, Nduna, Philotheou & Winberg, 2005). When new graduates enter the workplace, they are expected to have reached a certain level of clinical competence which will enable them to perform their professional duties.

This chapter outlines the radiography qualification with a specific focus on the development, structure and constraints of the clinical component. The purpose and significance of the research are explained together with the research questions.

In this thesis I argue that the clinical competency requirements of the South African diagnostic radiographer compares well with international standards of clinical proficiency of newly qualified radiographers; however South African radiographers are lagging behind their UK counterparts in respect of role extension. This thesis further argues that there are significant differences in the understanding of academics and

clinical practitioners regarding the clinical competency requirements of newly qualified diagnostic radiographers. The thesis recommends a model for clinical performance and its assessment to bridge this difference.

The focus of this research is on the clinical competencies required of newly qualified diagnostic radiographers in South Africa. In order to understand the context of this research, the following needed some consideration:

1.2 The radiography qualification structure

In South Africa presently diagnostic radiography qualifications are offered at both Universities of Technology and traditional Universities. Universities of Technology traditionally offer a National Diploma while the traditional Universities offer a first degree. The duration of both qualifications is three years. This research represents the participation of the seven Higher Educational Institutions (HEIs) in South Africa offering a diagnostic radiography qualification[1]. The present radiography qualification (being the National Diploma or first degree) has interim registration with the South African Qualifications Authority (SAQA).

After the general election in 1994 there was a change of power from the National Party to the Government of National Unity. As a result, the Department of Education began an extensive revision of the South African educational system. The SAQA Act (No. 58 of 1995) and the Higher Education Act (No. 101 of 1997) signalled the Department's intentions to restructure Higher Education (Du Pré, 2000). These acts required that

[1] At the time of the initiation of this research, the records supplied indicated that there were seven HEIs in South Africa offering a diagnostic radiography qualification. Since then, there are in fact eight HEIs that offer radiography.

courses adopt an outcomes-based approach. The White Paper on Higher Education (H.E) in South Africa is a formal expression of the government's intention to transform H.E. in order to, firstly meet the needs of a democratic country and secondly, to be able to accept the challenge of globalization (Edrong, 2000). It was in this context that SAQA (South African Qualifications Authority) and NQF (National Qualifications Framework) were established (Oliver, 1998). The New Academic Policy for Programme and Qualifications in Higher Education discussion document (NAP) is an attempt to implement the vision and goals of the White Paper. In this document, an outcomes-based model of curriculum design is proposed.

Van Der Horst and Mc Donald (1997) are of the opinion that one of the underlying beliefs of OBE is that every student must be educated to their full potential. They feel that lecturers and students should have a high expectation of success regardless of the students' background. They also see a need for the involvement of all stakeholders in decision- making. In keeping with the new legislation, the traditional radiography curriculum was re-written as outcomes and registered with SAQA in 2000 (Engel-Hills, 2005a).

The process of developing outcomes for the radiography qualification was a national one that involved all the HEIs and their respective clinical affiliations. The then Peninsula Technikon was the convenor Technikon for this process. There are six stated exit level outcomes all of which have a clinical competency component. The exit level outcome comprises 360 credits over a three-year period. Du Pré (2000) describes a credit as the value given to a number of notional (estimated) hours of learning. A

SAQA credit is equal to ten notional learning hours and 120 SAQA credits are roughly comparable to one year of full time study. He further describes notional hours of learning as the estimated learning time taken by an average learner to meet the outcomes. This time includes concepts such as contact time, structured learning time in the workplace and individual learning.

The purpose statement for the 360-credit diagnostic radiography qualification was developed in 2000 for the interim registration with SAQA as follows:

> A person achieving this qualification will be competent to apply scientific knowledge, practical and clinical knowledge, skills and insight to practice independently in the health care team up to level 3 care (SAQA, 2000).

The 6 exit level outcomes are:

1. Apply scientific knowledge and skills to perform and adapt diagnostic techniques applicable to the clinical presentation for the optimum benefit of the patient.
2. Assess radiographic images for quality and pattern recognition.
3. Care for the patient responsibly and effectively to ensure the welfare and safety of the patient is maintained.
4. Apply appropriate health and safety regulations, ethical principles, guidelines and codes of practice in the performance of radiography to ensure personal and public safety.
5. Utilise theoretical knowledge of management practice to manage human, technological and other resources to ensure optimal and cost effective quality and radiographic services.

6. Access, utilise and communicate information applicable to the radiographic services.

The following Critical Cross Field Outcomes (CCFOs) are included (as adapted in SAQA, 2000 from Van Der Horst & McDonald, 1997):

1. Identifying and solving problems which display that there was creative and critical thinking in diagnostic imaging.
2. Working effectively with others in the health care team and educational environment.
3. The ability to manage self with respect to learning, radiographic work and personal contexts.
4. Communicating effectively in the learning and health care environment.
5. The use of science and technology in radiographic imaging.
6. High level of information literacy
7. Understanding the place of the diagnostic radiographer within the national health and social system.

In 1994, the "Technikons" became degree granting institutions. University of Technology degrees are called Bachalearus of Technologae (B Tech) and the first students graduated with a B Tech (Radiography). A pre-requisite for this qualification is a National Diploma (Radiography). This degree is traditionally offered as one-year full time study or two years part-time study. The emphasis of this degree is on equipping the student with management and research skills. The University equivalent of this is a Bachelor of Radiography Honours: Diagnostic.

1.3 The structure of the radiography program

The education of radiographers comprises both classroom-based theoretical instruction, consisting of subjects such as Anatomy, Physiology, Pathology, Radiation Science and Equipment, Radiographic Practice, Psychodynamics of Patient Care and Management; and supervised practice in the clinical environment. The education of radiography students therefore involves both theoretical and clinical components as outlined in figure 1.1.

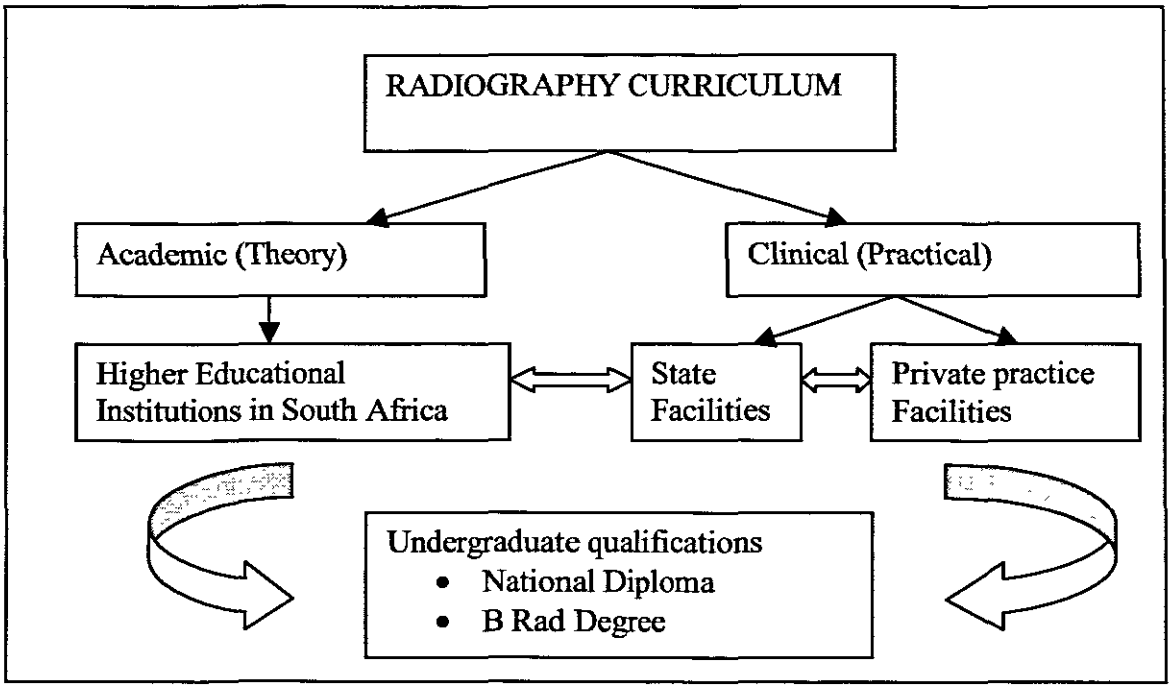

Figure 1.1 The radiography curriculum structure

With reference to figure 1.1. above, the academic component of the curriculum is facilitated by the radiography lecturers employed by the HEIs, while the clinical component is facilitated either by radiography lecturers who have a joint appointment with the HEIs and the clinical facilities affiliated to the respective HEIs or there are specifically appointed clinical tutors affiliated to the respective HEIs. The clinical component of the curriculum is compulsory and the Health Professions Council of

South Africa (HPCSA) requires that student radiographers register with them at the beginning of their education. The HPCSA also stipulates a minimum number of 2500 hours spent in experiential learning (i.e. the clinical working environment) before registering as a qualified radiographer. The clinical component is the practical work of a diagnostic radiographer, which first and foremost is the imaging of patients using technologically advanced equipment. Broadly speaking, the clinical components of the six stated exit level outcomes require that the qualified diagnostic radiographer possess the following core clinical competencies, namely: accurate and safe use of complex technology, production of high quality images for purposes of diagnosis, patient care, working professionally and ethically as a member of the health care team and managing an imaging department. These core clinical competencies define a professional radiographer. One may argue that some of these competencies are only achievable once the graduate starts working and perhaps also after a certain amount of experience (Edgren, 2006).

1.3.1 General limitations in respect of clinical education

Sanson-Fisher, Rolfe and Williams (2005) drawing on the work of various authors, are of the opinion that there are certain limitations to the current methods of teaching clinical skills in the undergraduate medical education programme. These limitations discussed below are transferable to the clinical education of undergraduate radiographers and will impact on the workplace preparedness of the newly qualified radiographer.

1.3.1.1 Patient availability

The availability of a variety of patients is crucial so that students learn to communicate, manage and image a variety of cases, however this is not always possible because changes in the health care delivery system have meant that patient variety in teaching hospitals is becoming restricted. There are also a variety of clinical platforms (e.g. state hospitals, private practices, community health centres) where radiography students experience their clinical education. These different clinical platforms may provide different clinical learning experiences and opportunities for the student because of the variety of patients seen at these platforms. The availability of resources of these clinical platforms varies and there are more technologically advanced imaging systems installed in some facilities.

1.3.1.2 The clinical timetable

The arrangement of the clinical timetable is critical as exposure to cases may vary according to when and where the students undertake a particular "block". In the context of this research, the "block" refers to the particular clinical area the student is assigned to. The design of the academic and clinical programmes for radiography may vary nationally. Clinical teaching needs to reflect the clinical work environments which involve working at night as well.

1.3.1.3 Clinical supervision

The staffing and amount of time available for teaching purposes is often restricted due to practitioners becoming increasingly busy as a result of constraints such as increased workload and reduced staff capacity. Certain HEIs have a joint appointment structure

where the academics are also involved in the clinical tuition of students in the clinical setting, while other institutions have specially appointed clinical tutors. This may affect the quality of clinical tuition that students receive.

1.3.2 Radiography specific issues

There are factors specific to radiography, which limit the current methods of teaching clinical skills and hence the preparedness of the new radiography graduates. These are highlighted below:

1.3.2.1 Design and implementation of the clinical curricula

Currently there are two undergraduate qualifications for diagnostic radiographers in South Africa, namely a National Diploma and a Degree. There may be differences in the way these two courses are structured. Even though the process of developing the outcomes was a national one with all relevant stakeholders involved in the process, the design of the clinical curricula around the outcomes inevitably varies. Furthermore, implementation of the various curricula with regards to the academic and clinical components is likely to vary as radiography students may be exposed to the clinical environment at different stages in their education.

1.3.2.2 Assessment practices of clinical competency

An additional aspect that may affect the workplace preparedness of the new graduate has to do with the assessment practices used to assess clinical competency. Issues such as whether student radiographers are assessed in simulated situations using standardised

patients or on actual patients in the clinical setting, will impact on the extent to which they are prepared for the workplace.

The way students learn is largely dependent on how they think they will be assessed (Biggs, 1999). Biggs (1999) refers to this concept as "backwash". Students' learning can either be deep or superficial where they either engage with the material (in this instance, the clinical environment) or in the latter instance, are passive recipients of information (Lambert & Lines, 2000). Clinical facilitators are thus directly responsible for the approach which students take because it is a reflection of their teaching styles.

Assessments of clinical competence therefore needs to be: fair in terms of their appropriateness to the teaching and learning approaches, valid in terms of whether it is measuring what it is intended to measure, reliable in terms of absence of bias by assessors, and practically feasible. Assessment principles need to be implemented in an ethical manner because the results of assessment have implications for the future prospects of the students (SAQA Policy Document, 2001).

The clinical curriculum needs to be assessed in a manner which incorporates all levels of competency, i.e. practical, foundational and reflexive competence (SAQA Policy Document, 2001). This would then ensure what Biggs (1999) and Newble (1992) describes as "authentic/performance assessment" (also called "contextualized" assessment) which is aimed at encouraging students to think, decide, and act in real situations in an informed manner. Practicals, problem solving and case studies are examples of these. This is contrasted to declarative assessment (also called

decontextualised assessment) which is aimed at assessing "underpinning knowledge" which would probably suit the conventional written test method of assessment (Biggs, 1999; Newble, 1992). It would seem fitting to say then that the assessment method chosen must be appropriate for what it is intending to measure (validity). A badly designed assessment (i.e. an assessment which is invalid, unreliable and unfair), will result in superficial learning. Conversely, an assessment, which is aligned to the learning objectives and the teaching/facilitation, will result in deep learning (Biggs, 1999). The clinical curriculum needs to accurately reflect what the newly qualified radiographer is expected to do in the workplace (Newble, 1992) and the workplace also needs to take cognisance of what radiography educators are trying to achieve with outcomes-based education specifically with respect to the critical cross-field outcomes.

These various issues discussed above may impact on the clinical competency of the newly qualified radiographer; however the fact remains that when new graduates enter the workplace, they are all expected to have reached a certain level of clinical competence even though their clinical experiences may have been different. My interest is in the translation of the clinical outcomes into clinical competencies. As a diagnostic lecturer and clinical facilitator myself, I identified the need to develop nationally consensus on the clinical competency requirements of newly qualified diagnostic radiographers. As discussed, clinical education may vary nationally. This variation may translate into a variety of clinical competencies as well as levels of competency which students may acquire depending on their clinical placement. While this variety may be useful, I feel that it is necessary to develop a practice domain model which equips all diagnostic radiographers with generic transferable clinical

competencies which are the hallmark of a diagnostic radiographer in South Africa today, and in the future.

Currently there are no nationally agreed- upon standards to guide clinical performance assessments of undergraduate diagnostic radiography students. Radiography educators cannot be sure that what they are assessing at undergraduate level is a true reflection of the clinical performance abilities required by newly qualified radiographers. There is thus a need to get national consensus on the clinical competencies required by newly qualified diagnostic radiographers in order to better understand the implications for clinical assessments at undergraduate level.

1.4 Rationale for the Study

The practical reason for this research is to develop a "blueprint" for the clinical competencies that should be assessed at undergraduate level. The clinical outcomes for the diagnostic radiography qualification have interim registration with SAQA. They were developed nationally through input of stakeholders in diagnostic radiography. The result of this process can be likened to the development of the "intended curriculum" as illustrated in the model (figure 1.2) adapted from Remmen (in Moercke & Eika, 2002) as that which is desirable and put on paper. The "curriculum in action" is that which is taught to the students and the "learned curriculum" is what the students actually learn. Ideally there should be a complete overlap of the three facets.

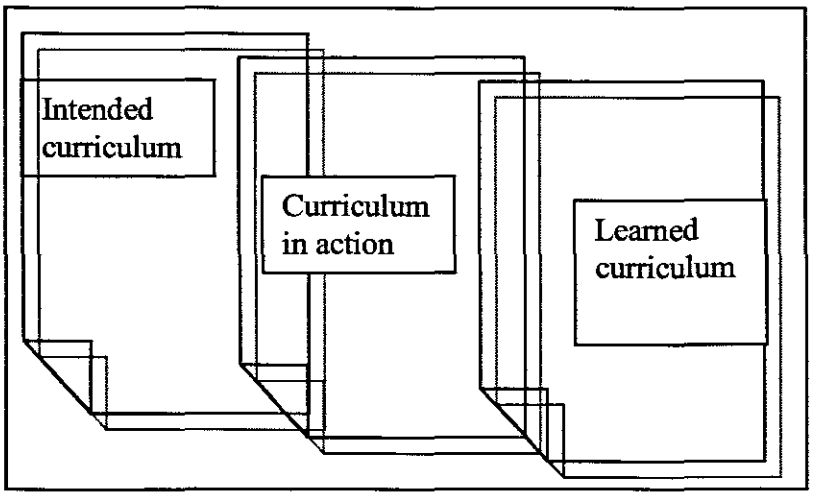

Figure 1.2 A clinical skills training curriculum model adapted from Moercke and Eika (2002)

In a sense, this research also evaluates whether the intended curriculum is in fact achievable. Within the theoretical context, this research aims to identify the practice domains of the radiographer today in South Africa based on the model of Melnick, Asch, Blackmore, Klaas & Norcini (2002) illustrated in figure 1.3 below.

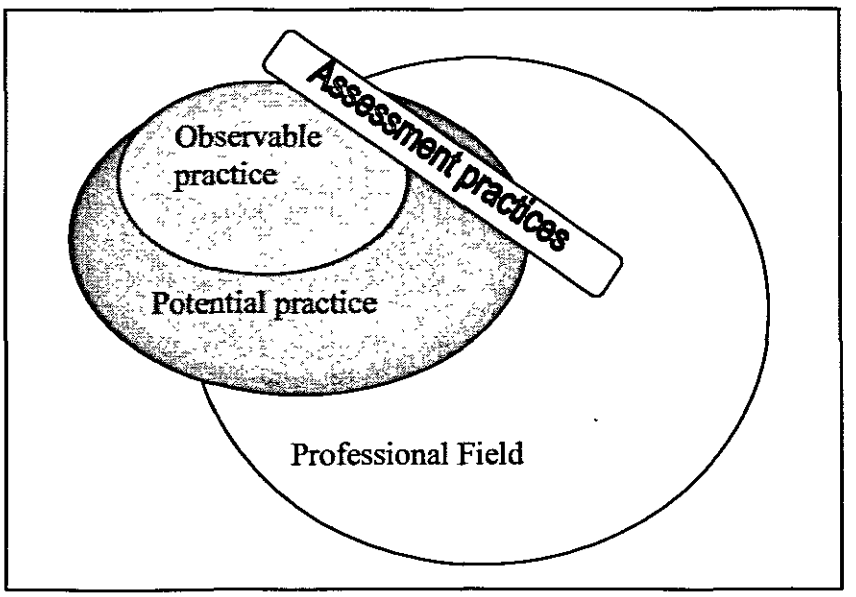

Figure 1.3: Practice Domains and Assessment Practices (adapted from Melnick et al, 2002)

In this model, *Observable practice* is what the radiographer is observed doing in practice; *Potential practice* is what the radiographer does not ordinarily do (e.g.

unconventional or uncommon practices, but where there is a reasonable expectation that this can be done) and the *Professional field* is the holistic practice that encompasses all of the above as well as the key competencies depicting professional behaviour, i.e. values, attitudes and ethical behaviour (Melnick *et al.*, 2002).

Internationally there has been much development of role extension (extended scope of practice) of diagnostic radiographers (Nightingale & Hogg, 2003). However, role extension for diagnostic radiographers in South Africa has lagged behind, possibly because the need has not been identified and an environment of medical dominance still exists (White & McKay, 2002).

Although the focus of this research is on the observable practice, to fully develop the practice domain model of Melnick *et al.*, (2002), it is necessary to also explore where each of the clinical competencies identified, fits into the practice domain model. So while role extension is usually developed with clinical experience as advanced practice, it is necessary to consider it when discussing the practice domain model and argue for possible inclusion in some form in the undergraduate clinical competence expectation. The questionnaire design thus includes role extension opportunities some of which are currently part of the scope of practice of the radiographers abroad (Nightingale & Hogg, 2003; Ward, 1998; Brealey, King & Warnock, 2002) in order to explore these for the South African context.

1.5 The Research questions

This study looked at the clinical competencies required of newly qualified diagnostic radiographers in South Africa. This research investigated the alignment between undergraduate radiography education and the workplace requirements in order to inform the clinical assessment practices of undergraduate radiography. The purpose of this research was to contribute to the development of defensible standards for the clinical performance and hence clinical assessment of exit-level radiographers. In order to investigate this, the following research questions were asked:

1.5.1 What is expected of new graduates in the workplace?

Given that the clinical education of diagnostic radiography students varies nationally, this research question sought the input of both radiography academics and clinical practitioners nationally on the clinical competency requirements of newly qualified diagnostic radiographers in South Africa. Through the Delphi process, it was possible to develop consensus of opinion on these competencies as well as identify areas of divergent opinion. An opportunity for panellists to provide opinion on role extension opportunities was also afforded.

1.5.2 Is there a gap between the clinical curriculum and performance skills?

Through an analysis of the results of the Delphi study, it was possible to reveal discrepancies between the clinical curriculum (clinical expectations) and workplace requirements. A comparison was drawn between the model adapted from Remmen (in Moercke and Eika, 2002) (figure 1.2) which investigates the overlap between the intended curriculum, the curriculum in action and the results of this study.

1.5.3 What are the implications of the clinical competencies identified for benchmarking undergraduate assessment practices?

The identification of the clinical competency requirements of newly qualified diagnostic radiographers enabled the model of practice domains (adapted from Melnick *et* al.,2002) (Figure 1.3) to be developed for the diagnostic radiographer. A new model for the assessment of clinical performance was also developed based on the results of the Delphi study.

1.6. Significance of the Research

This research is important as it investigates various facets of radiography, namely: the clinical curriculum, clinical assessment practices and standards of proficiency, and the results attempt to:

1. Inform the national process of the professional board of radiography's Standards Generating Body (SGB);
2. Facilitate the national harmonization of clinical practices of radiographers;
3. Provide opportunity for comment on role extension and the scope of practice of the radiographer;
4. Inform assessment practices by providing a consensus of opinion nationally on what skills ought to be assessed; and
5. Assist radiography educators and practitioners to align educational outcomes with workplace needs.

A potential application is that this method could be used to guide the development of standards for other health care professions.

1.7 Delimitation of the Research

There are three ways in which this research project has been delimited. These are described below:

- This study determined the basis of a standard for the assessment of *clinical performance* only with respect to the skills required of *entry-level* diagnostic radiographers in line with the practice domain model as proposed by Melnick *et al.*,(2002).
- The experts recruited for this study were limited to seven of the possible eight HEIs in South Africa who offer a diagnostic radiography qualification.
- The participants from whom consensus opinion was sought were the diagnostic radiography lecturers employed by the HEIs and radiography practitioners in the clinical environments affiliated to the HEIs.

1.8 Assumptions

There were two assumptions made at the start of this research project and they both relate to the selected sample, namely that:

- All the Heads of the Radiography programs at the seven HEIs would give their consent to participate fully in the research process. This assumption proved to be correct as all the programme heads gave permission to conduct the research.
- All the nominated "expert" participants would consent to taking part in the research and would give their full co-operation throughout the data collection phases for at least three rounds of questionnaires. All the nominated panellists agreed to serve on the panel, however, the response rates of the panellists

indicated that not all the panellists completed all three round of the questionnaire.

1.9 Introduction to the thesis structure

Below is a brief outline of the structure of the thesis.

Chapter Two

In this section, I discuss the process of developing standards for clinical practice, as well as issues relating to clinical competency, the assessment thereof and role extension opportunities, for the purpose of developing a model for clinical competence of the South African diagnostic radiographer.

Chapter Three

In this section, I explain the philosophical and methodological basis of the Delphi technique, as well as how this technique was applied to develop consensus on the clinical competencies required of newly qualified diagnostic radiographers.

Chapter 4

The findings of the national consensus development process of the Delphi technique on the clinical competencies requirements of new graduates are presented in this section.

Chapter 5

In the final chapter, I present a practice domain model adapted from Melnick *et al.*, (2002) for diagnostic radiographers in South Africa. A model of clinical performance is also presented. Conclusions and recommendations are also made which highlights the need for further collaboration between the various stakeholders involved in the clinical education of student radiographers.

CHAPTER 2

AN OVERVIEW OF THE LITERATURE ON STANDARDS AND CLINICAL COMPETENCE

2.1 Introduction

The focus of this research is on the clinical competencies required of newly qualified diagnostic radiographers in South Africa in order to enhance the alignment between undergraduate clinical education, assessment practices and workplace preparedness.

The chapter starts with an overview of the literature regarding standard setting in clinical practice. This is an important consideration because the validity and reliability of the study hinges on an acceptable process of standard setting. This is followed by a review on what constitutes clinical competence and how to assess it in the clinical setting. A discussion on the various facets of the clinical curriculum follows this. Literature regarding the developing role of the radiographer is also explored in terms of the national and international context.

2.2 Standards and clinical practice

In this section, I draw upon theory and research around the need to develop standards of clinical competency and the structure and process of standard setting. This is followed by a summary of the standards of clinical proficiency for registration of newly qualified radiographers in the United Kingdom. The results of this research are then compared to these standards as well as those of the American Registry of Radiologic Technologists (ARRT).

2.2.1 The context of standard setting in South Africa

Hays, Miller, Booth, Harris, Harris, & Stirton (1998) claim that the diversity of what clinicians do in practice, in combination with lack of guidelines with regards to what is desirable or appropriate, has necessitated the development of general practice standards for medical doctors. At present there are no written standards of proficiency for radiographers in South Africa. The HPCSA Professional Board for Radiography and Clinical Technology was established in February 2004 (Health Professions Council of South Africa 1a, n.d). The professional boards operate as Standards Generating Bodies (SGBs), their function being to develop policy documents to guide the professions and oversee education and training outcomes (Health Professions Council of South Africa 1b, n.d). The standards of proficiency still need to be written for the South African context (Kekana, 2006). Currently the Board's standards generating process of restructuring the radiography qualifications to bring them in line with the SAQA guidelines, is underway (Kekana 2005). The process of writing standards of proficiency will commence once the Board's standards generating process of restructuring radiography qualifications, is completed.

In a sense, radiography in South Africa today is in a similar position to the one described by Hays *et al.*, (1998). The design of standards is based on two contextual issues; namely a fragmentation of the profession and absence of a shared vision among key stakeholders as to what constitutes quality practice (Hays *et al.*, 1998). Within the context of this study, it is such a shared vision or consensus opinion that is sought in order to develop the standards for clinical competency and thus enhance the quality of the assessment of clinical practice.

2.2.2 The structure of standards

The Health Professions Council of the United Kingdom in collaboration with various stakeholders has written standards of proficiency for the Health Care Professions which they regulate (Health Professions Council of the United Kingdom, 2003). These standards have generic elements as well as profession-specific elements and are summarised in table 2.1.

Table 2.1 Summary of the standards of proficiency for radiographers in the UK.

Expectations of the Diagnostic radiographer
1. Professional autonomy and accountability. **Registrants[2] must:** ▪ be able to practice within the legal and ethical boundaries of their profession ▪ be able to practise in accordance with current legislation governing the use of ionising radiation for medical and other purposes ▪ be able to practise in a non-discriminatory manner ▪ be able to maintain confidentiality and obtain informed consent ▪ be able to exercise a professional duty of care ▪ know the limits of their practice and when to seek advice ▪ recognise the need for effective self-management of workload and be able to practice accordingly ▪ understand the obligation to maintain fitness of practice ▪ understand the need for career-long self-directed learning *2. Professional relationships.* **Registrants must:** ▪ know the professional and personal scope of their practice and be able to make referrals ▪ be able to work, where appropriate, with other professionals, support staff, patients, clients and users, and their relatives and carers ▪ be able to interpret and act upon information from other health care professionals, in order to maximise health gain whilst minimising radiation dose to the patient ▪ be aware of the general working of health care services ▪ be able to contribute effectively to work undertaken as part of a multi-disciplinary team ▪ be able to demonstrate effective and appropriate skills in communicating information, advice, instruction, and professional opinion to colleagues, patients, clients, users, their relatives and carers

[2] Radiographers registered with British Health Professionals Council

- be able to advise other health care professionals about the relevance and application of radiotherapy or imaging modalities to the patient's needs
- understand the psychology of illness, anxiety and uncertainty and the likely behaviour of patients undergoing diagnostic radiographic procedures, as well as that of their families and carers
- understand the need for effective communication throughout the care of the patient, client or user
- be aware of the need to empower patients to participate in the decision-making processes related to their diagnostic imaging examination

The skills required for the application of practice

1. Identification and assessment of health and social care needs.

Registrants must:

- be able to gather appropriate information in a variety of formats and range of sources including patient history, radiographic images and biochemical reports
- be able to assess, monitor and care for the patient before, during and after irradiation
- be able to undertake or arrange clinical investigations as appropriate
- be able to interrogate and process data and information gathered accurately in order to conduct the imaging procedure most appropriate to the patient's needs

2. Formulation and delivery of plans and strategies for meeting health and social care needs.

Registrants must:

- be able to use research, reasoning and problem solving skills to determine appropriate actions
- understand the problems encountered at the patient-radiation technology interface and be able to find solutions to such problems
- be able to select and explain the rationale for examination techniques appropriate to the patient's physical and disease management requirements
- be able to draw on appropriate knowledge and skills in order to make professional judgements
- be able to apply the risk-benefit philosophy to radiation exposure to protect both individual patients and the population gene pool
- be able to calculate radiation doses and exposures
- be able to formulate specific management plans
- be able to conduct appropriate diagnostic or monitoring procedures or other actions safely and skilfully
- be able to perform the full range of plain film and standard contrast agent examinations, including trauma patients where the needs of the patients require non-standard imaging environments
- be able to manage and assist with fluoroscopic and complex contrast agent procedures
- be able to assist with CT examinations of the chest and abdomen in acute trauma cases, and contribute effectively to other CT studies

- be able to manipulate exposure and other imaging parameters to optimal effect
- be able to use to best effect the processing and related technology supporting film-based and computer-based imaging systems
- be able to maintain records appropriately

3. Critical evaluation of the impact of, or response to, the registrant's actions

Registrants must:

- be able to monitor and review the ongoing effectiveness of planned activity and modify it accordingly
- be able to audit, reflect on and review practice

Knowledge, understanding and skills

Registrants must:

- know the key concepts of the biological, physical, social, psychological and clinical sciences which are relevant to their profession-specific practice
- know how professional principles are expressed and translated into action through a number of different approaches to practice, and how to select or modify approaches to meet the needs of an individual
- understand the need to establish and maintain a safe practice environment

There are four content areas on which to base standards for general medical practice (Hays *et al.*,1998) which are similar to those of the British HPC. These have been adapted for the radiography context namely:

1. The role and responsibility of the radiographer in the imaging department.
2. The rights and needs of the patient.
3. Quality assurance and education.
4. Administration.

For purposes of this research, the standards which one sets for the clinical competency requirements of newly qualified diagnostic radiographers must take into account generic as well as profession-specific principles of clinical practice. Defining these standards will help to inform clinical assessment practices by improving their validity.

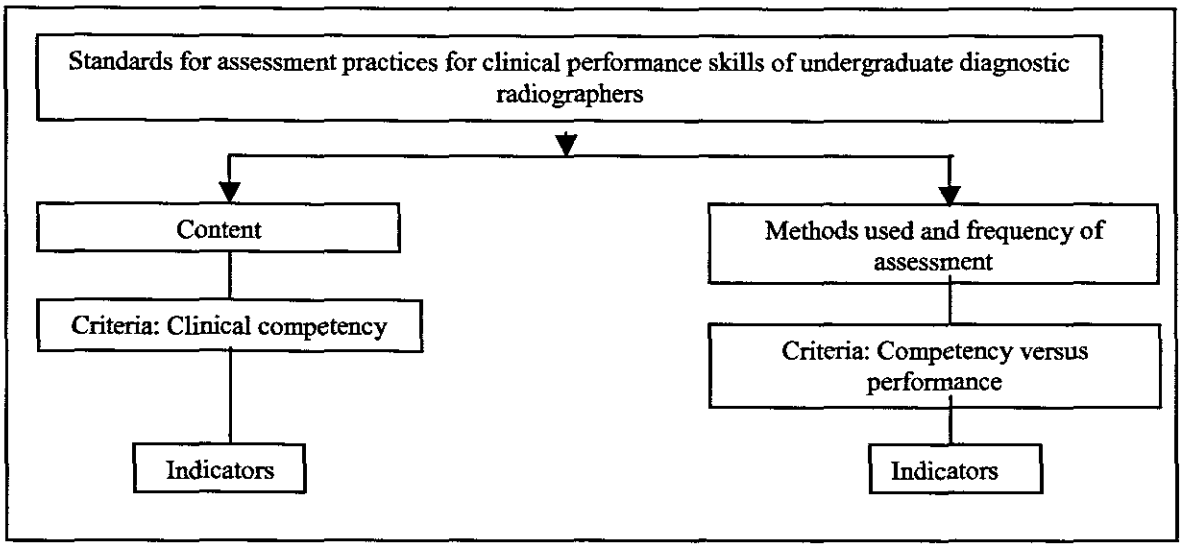

Figure 2.1 Model for standard setting, adapted from Hays *et al.*,(1998)

The model adapted from Hays *et al.*, (1998) (Figure 2.1) is a schematic representation of how to set standards. To summarise the model: the standard can be seen as the aim or overall statement; i.e. the standards for assessing clinical performance skills. In order to produce the standards, the contents of the standards need to be established. For purposes of this research, the content reflects the clinical competency requirements of new graduate diagnostic radiographers. The criteria for these competencies will be the consensus of opinion of a group of experts. The indicators are precise statements that are used to measure the achievement of each clinical competency.

With reference to assessment in Figure 2.1, this research highlights the differences between assessments of competency and assessments of performance [3]. Competency based assessments are measures of what individuals do in an assessment situation. Performance based assessments are defined as measures of what individuals do in practice under normal working conditions (Rethans, Norcini, Baron-Maldonado, Blackmore, Jolly, LaDuca, Lew, Page & Southgate, 2002). Given that radiography

[3] See appendix J, glossary of terms which provides definitions of these terms (page 184).

students spend a great amount of time working in the clinical environments, the expectation is that performance based assessments predominate.

2.2.3 The Process of developing standards

There are several standard-setting procedures available, some relying on quantitative methods and some on consensus judgements, or combinations of both (Southgate, Hays, Norcinin, Mulholland, Ayers, Wooliscroft, Cusimano, McAvoy, Ainsworth, Haist & Campbell, 2001). Any procedure used, inevitably requires a judgement to be made and the true worth of the method depends on its defensibility. Defensibility in this context is defined as "the ability to categorically establish acceptable or unacceptable performance" (Lew, Page, Lambert, Schuwirth, Baron-Maldonado, Lescop, Paget, Southgate & Wade, 2002). Lew *et al.*,(2002) further discuss the process of establishing defensible programmes for assessing Health Care Practitioners that takes the following adapted format:

1. Gathering information that describes what radiographers do in practice and;
2. Comparing that information with defined standards of practice performance (i.e. within the scope of radiography) and then arriving at decisions or judgements about the quality of that performance.

They suggest that for an assessment to be defensible, the data gathering process and the judgement process must be defensible. With reference to this study, the data gathering process would have to involve practitioners (i.e. experienced radiographers who supervise recent graduates and/or are involved in the undergraduate assessment of clinical practice) and educators with a view to seeking consensus.

In order to describe what radiographers do in practice, it may be useful to use the model based on one by Melnick *et al.*, (2002) (Figure 1.3, page 12) in their discussion on the structuring of performance assessment.[4] This model categorises the practice domains of a Health Care Practitioner and has been adapted for purposes of this research to include clinical assessment of these domains.

These domains (see Figure 1.3, page 12) consist of the observable practice, potential practice and the professional field. If we aim to prepare our students to perform effectively in the workplace, then our assessment practices should cover all the domains of practice. Exploring these domains in the radiography context may be useful in designing a basis for defensible standards for what should be assessed in clinical performance. This would assist in improving the validity of assessments of clinical performance skills.

2.3 Clinical Competence

I now turn to a discussion on the difference between clinical competency and clinical performance and the relationship between the two concepts[5]. This discussion is necessary as there are implications for the clinical education, and thus the clinical assessment of student radiographers. The discussion then goes on to describe the process whereby clinical skills are acquired (from the novice stage to the expert stage). This section concludes with the implications of competence on teaching and learning and the importance of involvement of all stakeholders in the design of the clinical curriculum to improve workplace preparedness.

[4] See appendix J for a definition of performance assessment (page 184).
[5] Refer to appendix J for the definitions on page 184.

2.3.1 Defining competence

Clinical competence comprises mastery of a body of knowledge as well as the acquisition of a range of relevant skills (Newble, 1992). Such skills include interpersonal, clinical and technical components (Newble, 1992). Competence, with reference to the radiography graduates, thus consists of knowledge, skills and attitudes that the graduate should exhibit *by the time of graduation* in order to cope successfully with the clinical environment that they encounter (Sanson-Fisher *et al.*, 2005). Furthermore, "clinical competence" has been loosely defined previously (Newble, 1992). A distinction must be made between the terms "clinical competence" and "clinical performance"; where "clinical competence" describes what the student is able to do at the end of the qualification and "clinical performance" is what the student actually does in clinical practice (Newble, 1992).

Figure 2.2 is a schematic diagram of how Newble (1992) sees the components of clinical performance. Clinical competence can be regarded as mastery of knowledge and the acquisition of skills, but is only of value when students are given learning opportunities to put these competencies into practice in the actual working environment. This model recognises that attitudinal aspects also influence competence and performance.

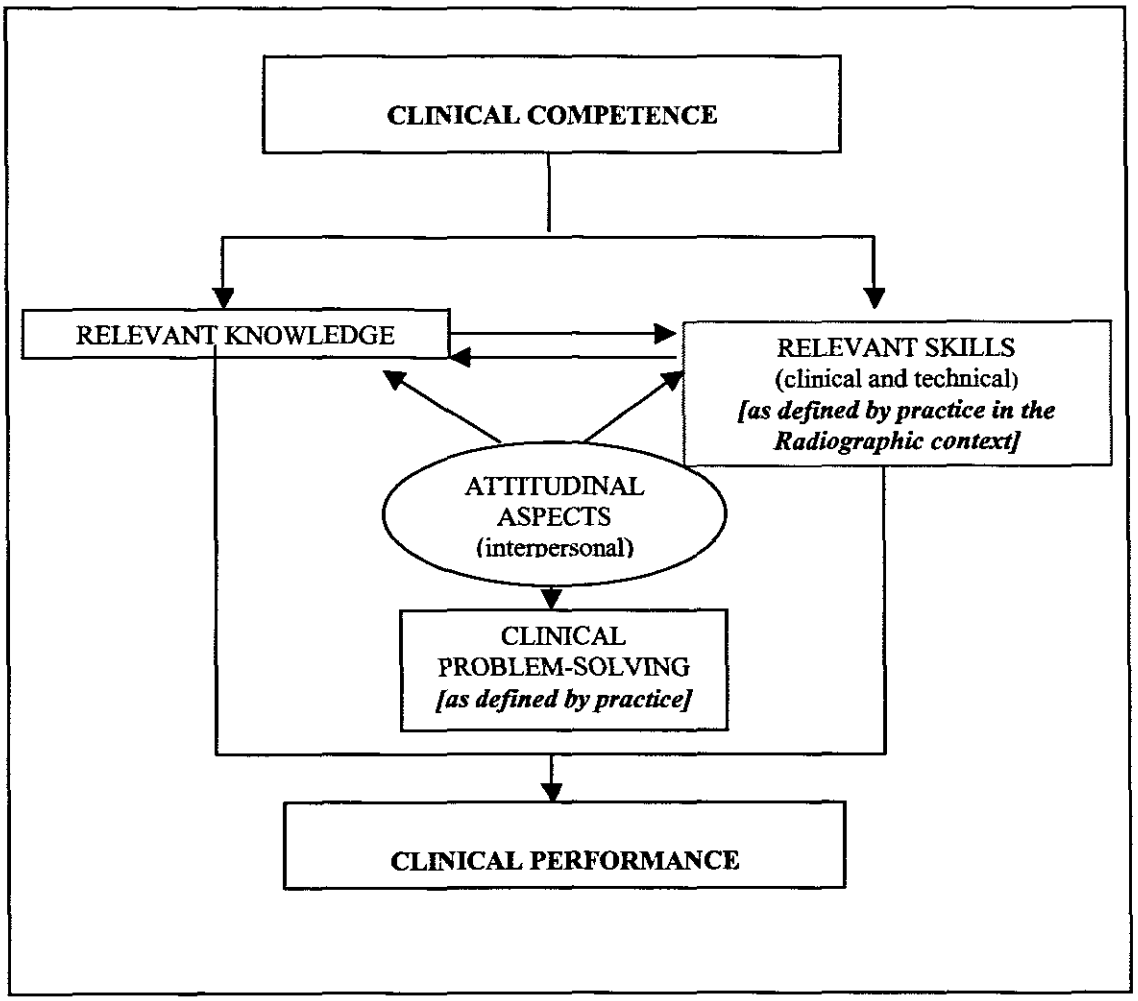

Figure 2.2: Components of clinical performance, adapted from Newble (1992)

It is the intention of this research to reveal the possible gap between the assessment of competence and performance [6] by defining exactly what clinical competencies are needed by newly qualified radiographers and then setting a "blueprint" for what should be assessed at under- graduate level. For the purposes of this research, the model has been adapted by the addition of *"as defined by practice"* because radiography practitioners have been recruited onto the panel to share their expertise on relevant workplace competencies. It would seem that assessments of clinical ability should assess the ability to perform practical tasks, but should also assess applied competence.

[6] Refer to appendix J for definitions (page 184)

This applied competence is similar to what Van Der Horst and McDonald (1997) refer to as "performance assessment" which assesses students' understanding, skills and disposition. The sentiment of "disposition" is also reflected by the "attitudinal aspects" as represented in the model by Newble (1992). Rethans *et al.*, (2002) and Newble (1992) make the same distinction between competency-based assessments and performance-based assessments. They see competency-based assessments as measures of what individuals do in an assessment situation, while performance based assessments are defined as measures of what individuals do in practice. The model of Miller's Triangle in Rethans *et al.*, (2002) (Figure 2.3) distinguishes competence as "showing how" and performance as "does".

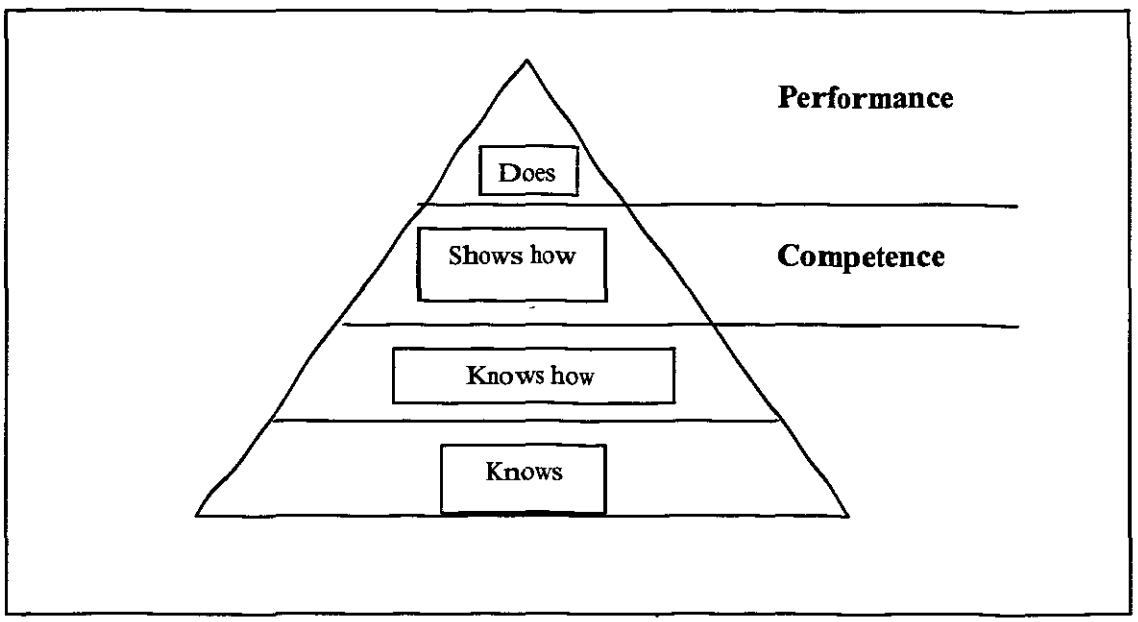

Figure 2.3: Miller's model from Rethans *et al.*, (2002)

Miller's Model shows the relationship between competence and performance assessment. He refers to "does" as an assessment of performance. Miller's triangle is seen as a static figure and so Rethans *et* al., (2002) propose a more flexible figure in the Cambridge model (Figure 2.4). This model sees competence as shedding light on performance and also recognises the influence of system-related and individual-related

influences that need consideration when assessing performance. Figure 1.1[7] in Chapter 1 highlights the structure of a radiography education program. Note on this figure the clinical component of the curriculum. By imaging patients in the clinical scenario, students will be exposed to the real "world of work". This would allow students to demonstrate their competence by performing actual imaging procedures as shown in the Cambridge model (Figure 2.4) (in other words, "performance-based assessments).

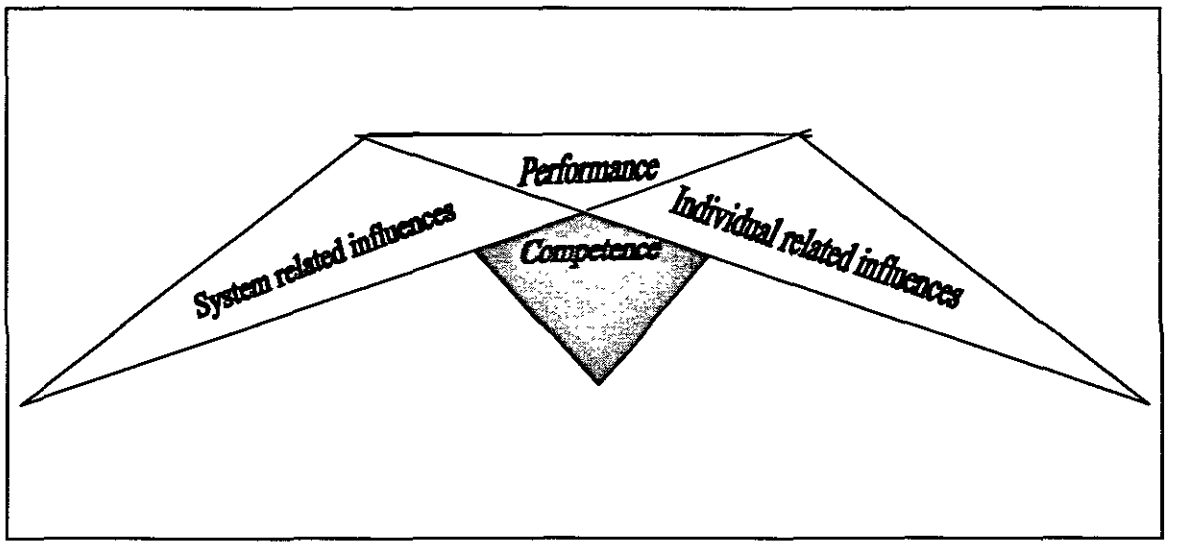

Figure 2.4: The Cambridge model by Rethans *et al.*, (2002), showing the relationship between competence and performance.

The theory is that not all problems related to an individual's performance might be explained by competence alone. These system and individual- related factors would seem to be equivalent to the interpersonal, clinical and technical skills mentioned in the Newble (1992) model (Figure 2.2, page 28) as well as the "professional field" in the practice domain model of Melnick *et al.*,(2002) (figure 1.3, page 13).

[7] On page 6

2.3.2 Acquiring competence

Benner (2001) describes the Dreyfus and Dreyfus model of skill acquisition as applied to nursing. This model has been adapted for the purposes of this research as I feel it is useful and necessary to define "competence" for the newly qualified diagnostic radiographer. Their model places competence on a continuum between the novice and the expert.

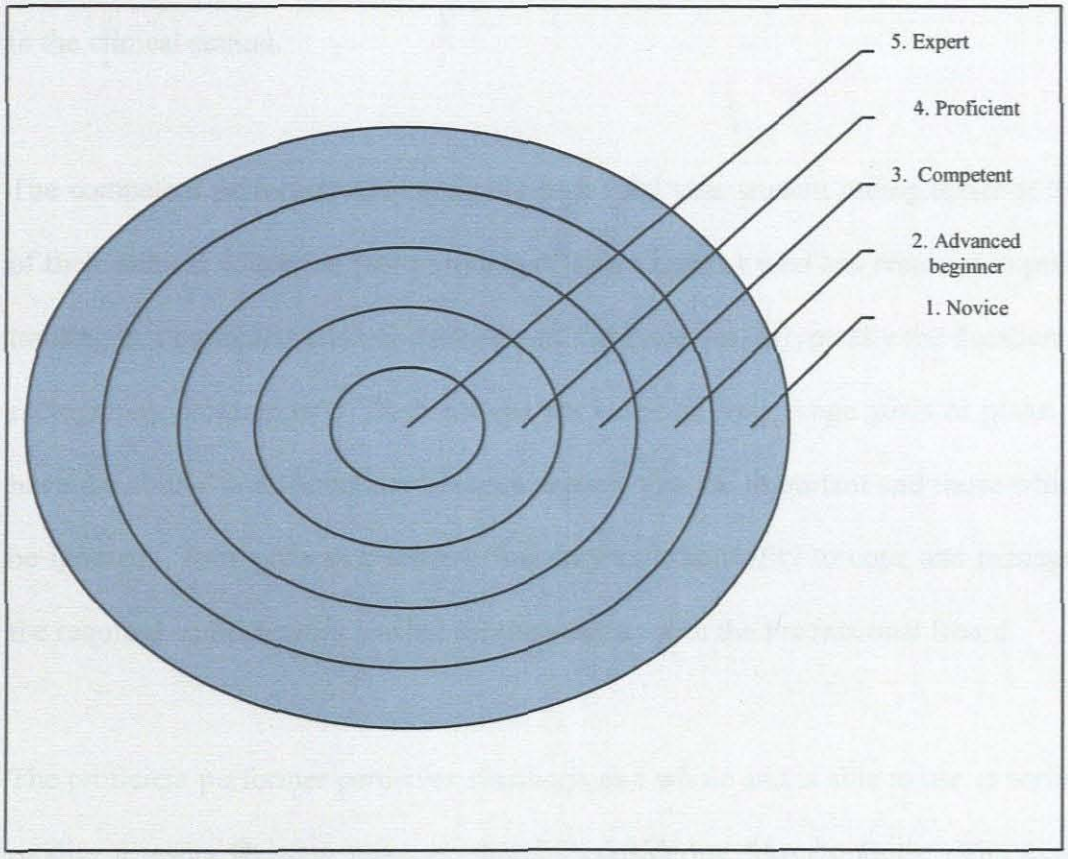

Figure 2.5: A schematic representation of The Dreyfus and Dreyfus model of skill acquisition (described in Benner, 2001), adapted for this study.

I have used the analogy of a "target" to demonstrate my understanding of their concept. The novice is seen as the person (student radiographer) who enters the clinical setting for the first time. They have no experience. There is no contextualization of the situation. They are reliant on abstract principles or rules (theory) to guide their performance. They are detached observers.

The advanced beginner is one who has coped with enough real situations (or have them pointed out by a mentor). Advanced beginners are able to recognise the aspects of a situation because there is some contextualization. They are able to apply the rules or guidelines know by the novice but are unable to adapt to different situations. The implications for teaching and learning are that those in this stage of skill acquisition need support in setting priorities and thus need to be "backed up" by a qualified person in the clinical setting.

The competent performer may typically be a final year student radiographer at the end of their clinical education (for purposes of this research) who has received experiential training in a particular clinical environment for three years (typically the duration of the radiography programme). Their actions are based on long range goals or plans. They have the ability to differentiate between aspects that are important and those which can be ignored. They possess a sense of mastery and the ability to cope and manage with the required competencies needed for registration with the Professional Board.

The proficient performer perceives situations as a whole and is able to use experience to modify a response using nuances, thereby considering fewer options. The expert no longer relies on an analytical principle (rules, guidelines, and maxim) to connect their understanding to an appropriate action. Experts have an intuitive grasp of the situation and are able to "target into the problem". This is borne out of a "deep understanding and experience".

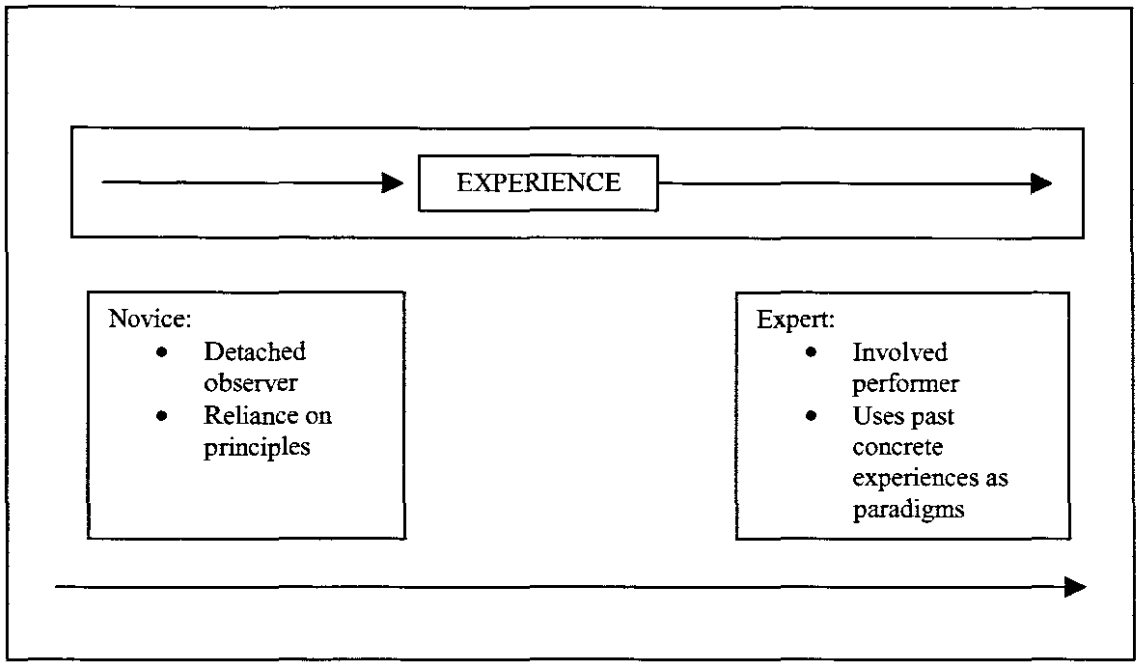

Figure 2.6 The notion of a novice-expert continuum

The notion of the novice-expert continuum is summarized in Figure 2.6. In terms of clinical competence and the profession of diagnostic radiography, it would seem fitting that there is collaboration by all the stakeholders in the development of the clinical curriculum which is the basis for developing clinical competency. All stakeholders (educators, practitioners and statutory bodies) involved in the radiography clinical curriculum should at least ensure that, students, upon qualifying should be declared "competent" based on the model presented by Dreyfus and Dreyfus (in Benner, 2001). There is an unscientific quality to the competent stage (Benner, 2001) and one can liken it to the saying, "The penny has dropped". It is the stage in skill acquisition that marks the realization of the clinical world and the functioning thereof (Benner, 2001). The implications for teaching and learning are that students should be allowed students to practice their planning and co-ordinating skills and decision-making skills.

2.3.3 A model of competence

There has been a transformation of the education of Health Care Professionals (HCP) in the United Kingdom where all basic qualifications are now linked to a Higher Education (HE) diploma or degree award (Williams & Berry, 1999). A similar trend is developing in the South African context, where the restructuring of the 3 year National Diploma or Degree in Radiography is to be replaced by a 4 year professional Degree. There has also been a move in South Africa to re-look at funding and delivery of the health service and the education system (Engel-Hills, 2005b). In this regard, there is an effort to develop collaboration between various stakeholders, namely health service providers and Higher Educational Institutions (HEIs). Universities and other institutions of the industrial society possess a specific shape and are able to function as they do because a fundamental agreement exists between society and science (Gibbons, 2005). Within the radiography context, this would imply that the HEIs and their various clinical affiliations function as they do because an agreement exists between academics and clinical practitioners.

The development of "learnerships" in diagnostic radiography in South Africa can be seen as a further development of this "agreement". Du Pré (2000) describes a "learnership" as "a structured learning programme which includes practical work experience, and leads to an occupationally-related qualification registered on the National Qualifications Framework (NQF)". The Sector Education Training Authorities (SETAs) are responsible for quality assurance of programmes and they report to SAQA via the Education and Training Quality Assurer (ETQA). As with any collaboration, there needs to be mutual agreement and co-operation with respect to relevance, cost-

effectiveness and quality. Williams and Berry (1999) present a "model of competence" of the new diagnostic radiographer (Figure 2.7).

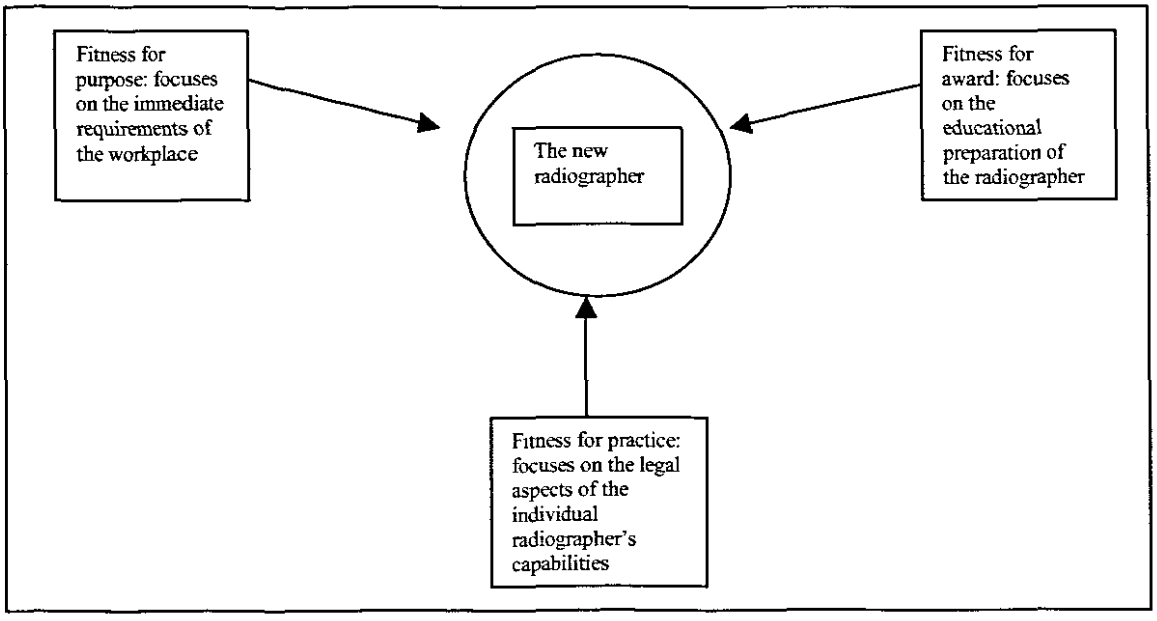

Figure 2.7: A model of competence (Williams and Berry, 1999)

From their model, it is evident that a model of competence is borne out of collaboration between various stakeholders. Within the context of this research, it is such collaboration which is employed to develop guidelines for standards on which to base the undergraduate assessment of clinical competence.

Professional competence is a contentious issue which is difficult to define because it is not just about performing certain tasks, but is also about an individual's attitudes, values and beliefs (Williams & Berry, 1999). It would appear that displaying professional competence is an ongoing developmental process. This concept is captured in the practice domain model of Melnick *et al.*, (2002) (Figure 1.3, page 13). The definition of "clinical performance" as developed by Rethans *et al.*, (2002) (Figure 2.4, page 30) also talks about individual related influences on competence.

Williams and Berry (1999) conducted a Delphi study with the aim of establishing a model of competence for newly qualified diagnostic radiographers in the U.K. Their study aimed at describing the primary role of the radiographer and after three successive questionnaires sent to 51 panellists and a group meeting, consensus was:

> The primary role of a radiographer is to care for the needs of the patient whilst producing high quality diagnostic images (Williams & Berry, 1999: 225).

This primary role statement is similar to the purpose statement in the South African Documentation (SAQA 2000). The purpose statement reads as follows:

> A person achieving this qualification will be competent to apply scientific knowledge, practical and clinical knowledge, skills and insight to practise independently in the health care team up to level 3 care (SAQA, 2000: 23).

The Delphi technique was also used in the study by Williams and Berry (1999) to develop categories of associated roles and responsibilities of the radiographer. The categories derived were: Professional; Health and Safety; Clinical; Technical; Administrative and Teaching and Learning. In their study, the panel were also required to predict the future role of the diagnostic radiographer as it was felt that when developing competencies, it would be realistic to strike a balance between present and anticipated roles because changes in health care provision and the patient's needs would impact on the radiographer. In response to this, educational change would have to be dynamic as the health care delivery system changes constantly (Akroyd & Wold, 1996; Engel-Hills, 2005b). The impact of these changes on standards would mean that recently published standards of clinical practice may quickly become outdated.

2.4 Assessment in clinical practice

This discussion starts with how to determine the content of clinical assessments. This is followed by a survey of the literature on the criteria which constitute fair assessment practices. The section then concludes with a brief discussion on the importance of aligning the clinical curriculum and assessment thereof to the requirements of the workplace.

2.4.1 How to determine the content of clinical assessment

In order to develop a rational and defensible approach to determining whether a student is clinically competent, one needs to be explicit about what one wants to assess (Newble, 1992). Newble (1992) suggests one can achieve this in a variety of ways, one of which is an undertaking of an analysis of the actual job the student will be expected to perform and the other is the use of an expert committee. The following three steps can be used as a guideline for determining what should be assessed (Newble, 1992):

1. Identify the problems that the students should be able to address or resolve.
2. For each problem, define the clinical tasks in which the student is expected to be competent.
3. Prepare a blueprint to guide selection of the problems and tasks to be included in the assessment procedure.

This process feeds into the model of Hays *et al.*, (1998) (Figure 2.1, page 24) used for developing general practitioner standards where:

1. The aim would be the identification of the problems. (step one of Newble's (1992) guideline above).

2. The criteria are the clinical performance tasks. (step two of Newble's (1992) guideline above).

Mc Leod, Steinert, Trudel, and Gottesman (2001) developed seven principles for teaching procedural and technical skills, one of which was: "Allow for practice under less-than-ideal conditions". For purposes of this research, the less-than-ideal conditions would refer to working in clinical practice (i.e. imaging a variety of patients presenting with a variety of conditions) and not in a simulated scenario, for example by demonstrating on models.

2.4.2 Criteria for assessment

There are three criteria that must be taken into account when developing any type of assessment: namely, *validity, reliability and practicability* (Newble, 1992). Newble (1992) sets validity as the priority. It would seem that an appropriate method of ensuring content *validity* is to ask supervisors of new graduates what they expect of them in terms of clinical competencies. The *reliability* of assessment depends on setting assessment criteria which will guide the assessor and the student. *Practicability* depends on the available resources for conducting assessments. It is recognised that to ensure validity and reliability of the assessments of clinical competency, expertise and creativity are needed to develop the best compromise between the ideal and the practical. This would imply a balance between competency- based assessments and performance-based assessments.[8]

[8] Refer to appendix J for a definition (page 184).

2.4.3 Alignment of assessment and workplace requirements

There is a need to explore what radiography managers expect of new graduates with regards to workplace skills (Akroyd & Wold, 1996). If there are discrepancies between what managers expect and what new graduates are able to do in clinical practice, this discrepancy would need to be addressed by educational change in the radiography programme. This change according to Akroyd and Wold (1996), would have to be dynamic as the health care delivery system changes constantly.

2.5 Defining and developing a clinical skills curriculum

Given the nature of radiography education with respect to the theoretical and clinical components, it would seem fitting that one looks at the clinical curriculum to see if it meets the expectations of all stake-holders (students, the profession, employers, HEIs).

In this section, I take a closer look at what the literature has to say about the clinical skills in the context of the various components of the curriculum. This section then concludes with a discussion on how the radiography clinical curriculum was developed and ends with the role that the Delphi technique could play in developing the clinical curriculum.

2.5.1 Components of the clinical skills curriculum

In order to develop a clinical skills curriculum, one would need to look at the clinical competencies required of newly graduated radiographers and then develop core clinical competency statements that would guide undergraduate clinical education. Remmen (in Moercke and Eika, 2002) proposed a model of the clinical skills curriculum which was

used to identify a clinical curriculum using the Delphi process. Remmen (in Moercke and Eika, 2002) defines the various components of the curriculum as follows:

> The *intended curriculum* is the part of the curriculum that is found desirable and put on paper. The *curriculum in action* consists of teaching the students, and the *learned curriculum* is what students actually learn. If there are considerable discrepancies between any of these three 'curricula' the education is neither effective nor efficient (in Moercke & Eika, 2002: 472).

It follows that the ideal situation would be where the intended curriculum, the curriculum in action and the learned curriculum are superimposed entirely.

2.5.2 The development of the radiography clinical curriculum and the role of the Delphi technique

The national curriculum of the clinical outcomes for diagnostic radiography was designed for the interim SAQA submissions in 2000 and collated by the then "Peninsula Technikon" as convenor Technikon. Various stakeholders from educational institutions and clinical practice nationally were invited to take part in the process. The process used to develop the outcomes was a version of the real-time or modified Delphi (Linstone & Turoff, 1975). This version of Delphi is conducted in a meeting and so the opinions of the panel are not anonymous unlike the conventional Delphi process. Because of the method used to derive the national clinical outcomes, one may expect that the intended curriculum is unrealistic. One advantage of the conventional Delphi is that panellists and their opinions remain anonymous to each other. This could assist in promoting a more honest opinion.

Moercke and Eika (2002) comment that designing educational outcomes is usually done by curriculum committees, but that the Delphi method has also been used in the curriculum design process. The Delphi study that they conducted identified 212 clinical

core skills needed by undergraduate medical students in Denmark. A 75% consensus was accepted. In a follow up study, the panel then attached a skills level to each skill. This was then given to newly graduated physicians for self-assessment. The study revealed that the learned curriculum of the clinical skills constituted 75% of the intended curriculum.

The task of their panel was to identify the minimum acceptable level and not the ideal standard for an undergraduate clinical curriculum. The intended curriculum was unrealistic and over-ambitious (Moercke & Eika, 2002). Their research suggested that a "top-down" approach to curriculum design runs the risk of not distinguishing ideal learning objectives from realistic ones.

2.6 The developing/expanding role of the diagnostic radiographer

In the context of rapidly changing health care delivery both nationally and internationally, this section deals with the developing role of the radiographer to meet the needs of these changes. Definitions of role development are explored. This is followed by a discussion on the need for role development and then proceeds to highlight areas where radiographers are actively engaged in role development. The ethical and legal issues of role development are also briefly highlighted.

2.6.1 Defining role development

Role expansion for radiographers has two facets: firstly, the traditional role expansion which encompasses the technological advances in imaging and secondly, the adoption

of roles previously undertaken by other HCP (Health Care Professionals) (White & McKay, 2002). Role extension as applied to allied healthcare practice is defined as:

> "...supplementary skills and responsibilities that extend beyond the statutory responsibilities and competencies at the point of professional registration. Consequently, role extension involves the post-qualification acquisition and development of skills and responsibilities with resultant associated additional professional accountability" (Hardy & Snaith, 2005: 328).

2.6.2 The need for role development

It is well documented that the nature of health care delivery is constantly changing and as a result of this "fluidity", new challenges and opportunities are emerging for all health care professionals (Engel-Hills, 2005b; Pettigrew, 2000; White & McKay, 2002).

Traditional roles held by HCPs are changing as service demands increase due to staff shortages and increased workloads. Professional roles are thus extended or developed out of a need. There is often resistance to these role changes as professionals try to protect their practice domains (White & McKay, 2002; Nightingale & Hogg, 2003; Snaith & Hardy, 2006).

Role extension for radiographers in the UK has been progressing steadily as the need has arisen due to a shortage of radiologists. White and McKay (2002) comment that role extension for radiographers is not as developed in countries where there are no apparent shortages of radiologists and thus an environment of medical dominance still exists. In the South African context, certainly within the urban areas, there does not seem to be a shortage of radiologists. This may not hold true for the more rural areas. With the decentralization of Health Care from the tertiary centres to the community health care centres, radiographers with extended roles may be required to deliver a quality service where there is none.

To meet the challenges of the changing health provision, role development should occur in two contexts, namely in education and in the workplace. Collaboration between educators and practitioners will address the educational context by ensuring that the undergraduate curriculum meets the demands of the changing workplace. Certain aspects of role development in the workplace can be addressed by continuing professional development initiatives, while the extended scope of practice can be addressed by post graduate education. The studies conducted by Akroyd and Wold (1996) and Kowalczyk and Mazal (2006) which investigated the workplace skills required of new graduates in the United States, revealed that radiography managers felt that the undergraduate clinical curriculum should develop the newly qualified radiographer so that they can, amongst other competencies:

1. problem solve and think critically;
2. perform basic QC;
3. function independently in theatre radiography;
4. perform CT;
5. utilise computers
6. care for the patient with respect to venipuncture, taking vital signs and monitoring patient equipment; and
7. possess total quality management and customer satisfaction skills

2.6.3 Areas of active involvement by radiographers in role development

A review of the literature on the expanded role of the radiographer for the workplace reveals the following developments:

1. Performance of barium meals and barium enemas in the absence of a radiologist (Ward, 1998; White & McKay, 2002; Nightingale & Hogg, 2003) as well as administration of intravenous "buscopan";
2. Reporting in the emergency departments (specially trained radiographers writing a full report on the examination as a radiologist would) (Radovanovic & Armfield, 2005; Brealey, King & Warnock, 2002; Donovan & Manning, 2006);
3. Reporting on intravenous urograms (Bradley, Rajashanker, Atkinson, Kennedy & Purcell, 2005);
4. Administration of contrast media and drugs, digital image processing, patient counselling, CPD schemes (White & McKay, 2002; Nightingale & Hogg, 2003);
5. Research and Evidence Based Practice (White & McKay 2002; Nightingale & Hogg, 2003); and
6. Participation in Red Dot Systems (White & McKay, 2002; Radovanovic & Armfield, 2005).

2.6.4 Ethical and legal implications of role development

Role development presents challenges both in the under graduate curriculum as well as the workplace and the student radiographer and radiographer thus face new levels of professional accountability (Pettigrew, 2000). Pettigrew concludes that:

> Consequently, it may be timely to review the delivery of all aspects of education provision within medical imaging, to ensure that the 'ethics' of our actions is considered every step of the way. Underpinning this more integrated approach is the need to define 'ethics' and then to provide undergraduate and postgraduate students with tools of ethical reasoning and problem solving, to ensure that they are able to manage a dynamic curriculum (2000:297).

Responsibility and accountability are inevitable with role expansion and therefore, radiographers who have expanded their roles or who intend to in the future, must be aware of the legal responsibilities. Guidelines and standards need to be set by registering bodies, professional bodies, employers and educators in order to support those undertaking role expansion opportunities (White & McKay, 2002; Hardy & Snaith, 2006; Hardy & Persaud, 2001). Additional accredited training must accompany any form of role extension. This point relates well with the model of competence presented by Williams and Berry (1999) with respect to the fitness for practice which focuses on the legal aspect of the individual radiographers abilities.

2.7 Summary of literature review

The main points of this literature review centers around the clinical competencies of the Health Care Professional with respect to how competence is defined, measured and assessed. The discussion has evolved around four theoretical models, namely:

1. The competence versus performance model of Miller (1990) and Rethans et al (2002)
2. The acquisition of clinical skills model of Benner (2001)
3. The clinical curriculum model of Moercke and Eika (2002) and
4. The practice domain model of Melnick et al (2002)

All of these models possess a common thread, namely to develop a better alignment between clinical teaching, clinical learning and clinical assessment and workplace needs.

CHAPTER 3

A RESEARCH METHODOLOGY FOR IDENTIFYING CLINICAL COMPETENCIES

> Taking a look at the kinds of information that can play a role in decision making, there are roughly three types. On the one hand, there are assertions that are highly confirmed- assertions for which there is a great deal of evidence backing them up. This kind of information can be called knowledge. At the other end of the scale is material that has little or no evidential backing. Such material is usually called speculation. In between is a broad area of material for which there is some basis for belief but that is not sufficiently confirmed to warrant being called knowledge. There is no good name for this middling area. I call it opinion. The dividing lines between these three are very fuzzy, and the gross trichotomy smears over the large differences that exist within types. However, the three-way split has many advantages over the more common tendency to dismiss whatever is not knowledge as mere speculation (Dalkey, 1969:2).

3.1 Introduction

This chapter begins by explaining the philosophical underpinnings of the Delphi technique. This is followed by an overview of the Delphi technique. The specific data-gathering and data analysis procedures of this research project are then explained, and the ethical issues arising from this research are given consideration.

3.2 Philosophical and methodological foundations of the Delphi technique

The Delphi process is essentially a process of communication and in order to give validity to this process, one has to have a philosophical basis or theory about the nature upon which that rests (Mitroff & Turoff, 1975) because this basis will undoubtedly affect the application of the technique. Philosophical bases of the research method can be described as "Inquiry Systems" (IS). Mitroff and Turoff (1975) identify the following Inquiring systems: Lockean; Leibnizian; Kantian; Hegelian (Dialectical) and Singerian. These IS can be differentiated from each other firstly by the priority assigned to the components (the components are the parts making up the system of

inquiry namely the data and theory and the sector in which the study is being conducted) and secondly by the degree of interdependence assigned to each of the system components. The Delphi is a prime example of a Lockean inquirer; it was originally Lockean and remains so primarily today still. The five main systems of inquiry are characterised below:

- Empirical consensus (Lockean IS)
- Analytic (Leibnizian IS)
- Multiple synthetic- an interdependence of empirical data and theory resulting in a contributory judgement (Kantian)
- Interpretive/Conflictual- exposing the assumptions of the experts in order to be creative in developing a new plan (Hegelian/Dialectical)
- Reflective/holistic/interdisciplinary (Singerian-Churchmania) (Mitroff & Turoff, 1975).

A summary (adapted from Mitroff & Turoff, 1975) of the five main theories of inquiry is illustrated in Table 3.1. This summary has been developed for the purpose of this study in order to see where the Delphi technique is located in comparison to the other four theories. It will also be referred to in the analysis and interpretation of the findings as well as in the recommendations for further areas of research.

Table 3.1: Theories of inquiry adapted from Mitroff and Turoff (1975)

Inquiry system	"Truth" component	Reality	Type of problems to be researched	Guarantor of validity	Critique/shortcomings
Lockean	Empirical (experiential /observational)	Not reliant on theory for data, only for the analysis of the data	Well structured problems where there is a sense of common agreement	Consensus /agreement by a group of experts	Emphasizes data to the detriment of theory Compromise may result
Leibnizian	Analytical	Theory based Formal, symbolic	Clearly definible , well-structured which have an analytical formulation and solution.	Precise specification of proof for a theorem or proposition Internal consistency, completeness, comprehensiveness	Emphasizes theory to the detriment of data Highly sophisticated model, with no concern for problems associated with data collection
Kantian	Empirical and analytical	Synthetic Theoretical and empirical components interdependent Data nor theory have priority over one another Theory and data are inseparable	Problems with a broader scope than the knowledge that any one of the individual possesses Ill-structured, neither pure Leibnizian or Lockean i.e. not consensus or analytical	Provision of alternative paths, "contributory" judgements	May overwhelm those who are used to a single best model
Hegelian (Dialectical)	Interpretive Creative synthesis of opposing views	Synthetic Data is not information, information is what results from the interpretation of data Truth is 'conflictual' The truth content is as a result of the existence of a plan and a counter plan. Data is meaningless without the plan and counter plan Opposing arguments are kept apart from the data	Extremely ill-structured problems requiring debate, opinions and assumptions of opposing experts- prediction and assessment of the future (used for Policy Delphi) Synthesis of two models then deciding on his own view	Intense conflict- the presumption that intense conflict will expose the assumptions underlying an experts point of view that are obscured because of agreement between experts Divergent and opposing conceptions of a plan and a counterplan Debate over the plan and counterplan in order to develop a new "all encompassing" plan Opinions of opposing experts	Conflict may be time-consuming for well-structured problems Assumptions
Singerian-Churchmanian	Language of commands, Reflective	Truth is Pragmatic No single component has priority over the other, holistic Synthetic, multi-model, interdisciplinary systems Meta IS, learning about self through the study of others and the world	Management of the application of all other IS Assumptions about laws and models Ethical presuppositions	Ethical presuppositions Forecasting the future with Highly refined, specific Diverse disciplines, professions, types of personalities Contrasting views Call for reflection of view stated More active involvement of the participants in the design and also how they experience the process etc.	

3.2.1 The Lockean Inquiry System

The philosophical trend that underpins empirical science is that of Locke (hence the term 'Lockean'). Mitroff and Turoff (1975) summarise the Lockean inquiry system as having the following characteristics:

1. The truth content of communication is linked completely with the experiential/observational content. The model presented by the output information of this research is an empirical model and the truth of this model is considered/calculated in terms of a) the researcher's capacity to condense every multifaceted suggestion/offer down to it's simple explanation and b) to guarantee the accuracy of the explanations between different observers (in the case of this research, panellists).
2. An outcome to (1) is that the reality of the model is not reliant upon any previous theoretical supposition. The researcher essentially starts with a "clean slate" comparable to Locke's *tabula rasa.* Lockean inquirers build their models up from the data input sector. (see Figure 3.2). In contrast the Leibnizian IS is based on *theoretical* deductions whereas the Lockean IS is based on *empirical* evidence. The underwriter of the Lockean IS has customarily been that of human agreement and the validity of this agreement is dependent on "ample extensive concurrence" by a group of "experts". A classic Lockean viewpoint is that it is not necessary to have a theory in order to collect data first; the theory is only needed to analyse the data afterwards.

3.2.2 The Delphi technique as a Lockean Inquiry System

The first use of the Delphi techniques by Dalkey, Helmer and Rescher at RAND is a classic example of Lockean inquiry (Mitroff & Turoff, 1975). Problems with the Lockean inquiry affect the Delphi as well with respect to the judgement process which may become more of a compromise and thus dissenting opinions may not be represented. The Lockean IS has the ability to explore a wealth of experiential data which may hinder the analytical capabilities of most Leibnizian (analytical systems). For purposes of this study, my understanding of a Leibnizian model is illustrated below in Figure 3.1.

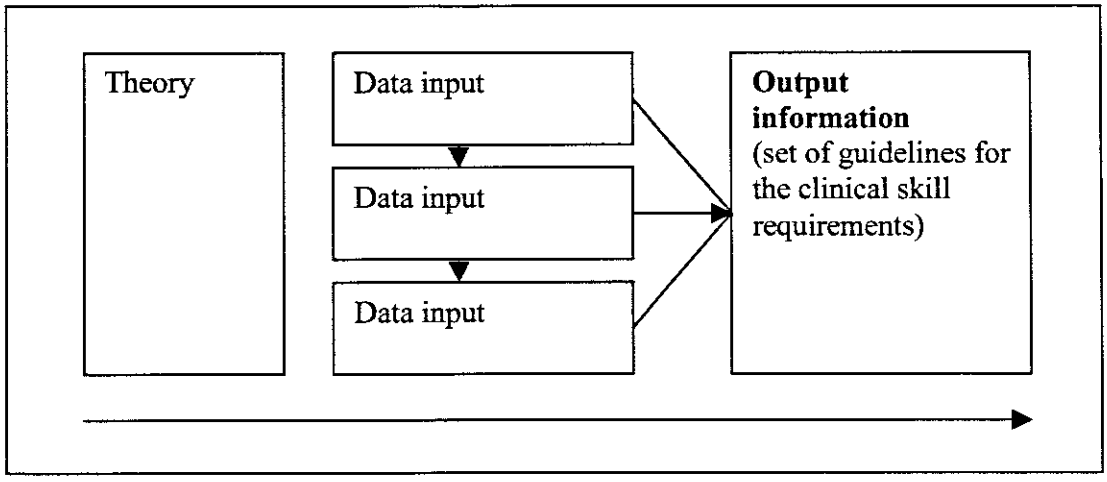

Figure 3.1: The perceived concept of the Leibnizian model.

The IS of this research begins with an 'assumed' event or raw data set (in this research, the list of clinical competencies required by newly qualified diagnostic radiographers) which we assume exists in the real world, (this Mitroff & Turoff, 1975) see as a Lockean IS). We begin to describe radiography clinical competencies and our knowledge of it by evoking a 'conceptualization' i.e. some sort of IS characterization of it. The process that then follows is a filtering one of the raw data in order to get it into a form for input into a model. This

model, which may be described as any form of a structured process, is defined by a set of rules that may be either algorithmic or heuristic in nature. The model, in this research, the guidelines for setting of standards for clinical performance, is evolved through a process of filtering and transforming the information so that the panel members (or decision-makers) can agree on a set of guidelines for the clinical competency requirements of newly qualified radiographers. This process is illustrated in Figure 3.2.

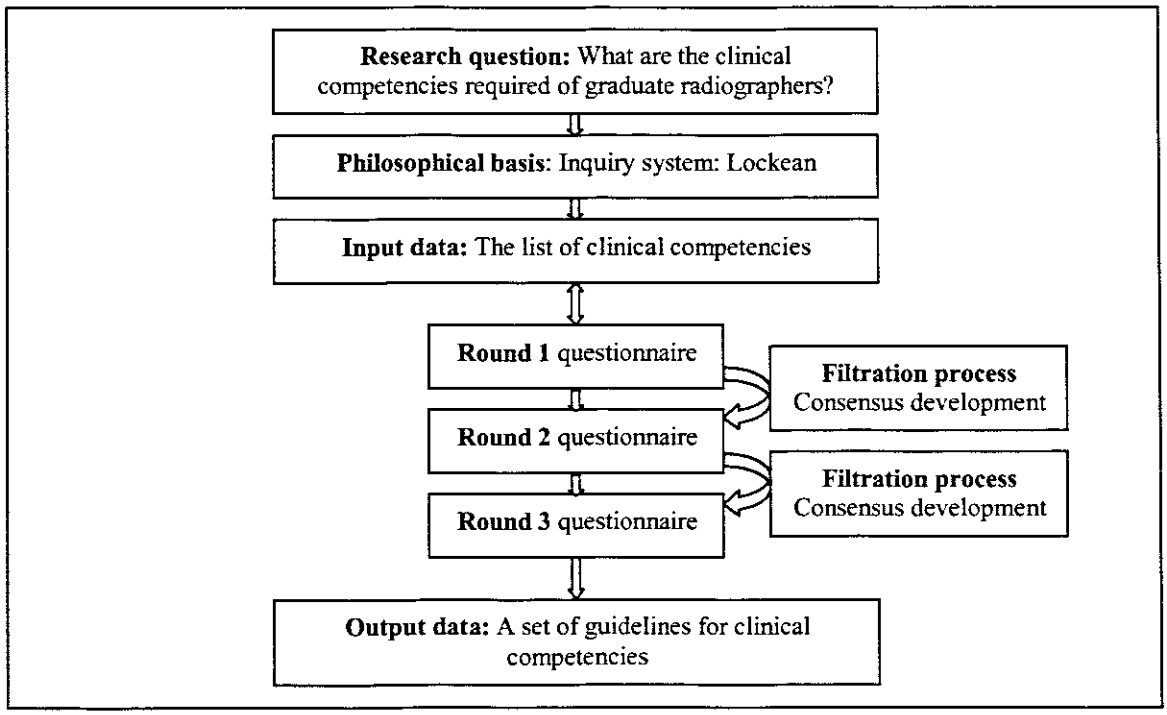

Figure 3.2: The process of the development of the model for this research

The raw data inputs are opinions or judgements of the experts and the validity of the results are measured in terms of the extent of the consensus among the experts. The Delphi is different from any other voting procedure because of the controlled feedback and the opportunity for panellists to reconsider their decisions.

3.2.3 Characteristics of Lockean IS

The conventional Delphi is an example of a Lockean IS (Mitroff & Turoff ,1975). The backer of authority of the Lockean Inquiry system is thus the "expert" and the light in which the results of the research is interpreted and implemented needs to reflect this. This is affected by what Scheele (1975) refers to as group interactive processes. He mentions that the experiences which individuals bring to a group are influenced by the context of the group. Issues such as personal esteem, the group's self-concept and world view for example will influence a group's response (Scheele, 1975). Such influences need to be considered when interpreting the results of this study. Scheele (1975) identifies the following group interactions:

- Transactions;
- Experiences;
- Episodes;
- Events;
- Affairs; and
- Occurrences.

The table below (Table 3.2) is adapted from Scheele (1975) for the purposes of this research project. A purposive sampling technique was applied in this research in order to constitute the panel of experts. One could say that the mode of interaction may encompass all of those listed below depending on the characteristics, personalities and environments that each of the panel members portray.

The researcher believes one could see this as strength of the Delphi process in this particular research. One could examine the types of interactions the individuals engage with on a day to day basis. This would reflect the opinions the panellist give in answering the questionnaires. The advantage of this could be that respondents who were perhaps used to engaging predominantly in a "event" interactions which is essentially ritualistic and one-dimensional may be positively influenced by respondent who predominantly engages in an "affair" interaction which is essentially unconventional and vice versa.

Table 3.2: Summary of types of group interactions adapted from Scheele (1975)

Group	Examples	Mode of interaction	Nature of realities produced
Collections of individuals	Respondents	Transactions	Obligatory, mechanical, possibly creating a new pattern e.g. broadening the scope of practice, ethics
Casual groups	Clique, players, class	Experiences	Distinctive, contented, with a strong interest in regularity, may suggest a significant new response
Purposive group	Colleagues, associates	Episodes	Firmly structured, factual, oppose redefinitions when alterations occur
Affiliative groups	Unions, professions	Event	Ritualistic, one dimensional, attempt to be dogmatic and sometimes produces a split
Defined group	Workforce, communities	Affairs	Working against pigeonholing, proclamatory
Agents for society	Representatives	Occurrences	Inclusive, inflexible, conforming, sometimes deteriorating into diffuse criticism

The three dominant modes of interaction in this study appear to be transactions, experiences and episodes. The following characteristics of the above-mentioned interactions are:

Transactions

1. Theoretical classification of the panellists by expertise with purposive sampling.
2. A formal statement of items for consideration.
3. Reiteration of responses categorised by original items with few additions.

4. The expected end result of the study being the collective judgement that will have authority greater than that of any individual.

Experiences

1. The panellists are familiar with which institutions are being represented, although not with the individuals.
2. The involvement is structured for a fixed period.
3. The original items (in this research, the list of clinical competencies) serve as starting point for further inquiry.
4. The broad form of the expected product of inquiry is openly communicated (for example guidelines for standards of clinical performance).

Episodes

1. Are made up of individuals who have an important and long-lasting relationship (professional in this instance).
2. Deal with well-known topics in familiar ways.
3. Are more concerned with the value of the interaction than the result.

There seems to be elements of interactions that could also be categorised as events and occurrences.

1. *Events:* "are guided in their interactions by 'the way things are done' (Scheele 1975) -e.g. in this study it could allude to the opinions that are guided by hierarchical considerations within the clinical departments.
2. *Occurrences:* Here the members (panellists) are made up of radiographers who understand that they are representing the interests of radiography in general as they

perceive it. The clinical competencies listed are intended to allow panellists to expand on their initial ideas. Most communications refer to particular inferences about the way things are supposed to be or are changed to statements that describe world-views, (e.g. certain clinical competencies are not within the scope of the radiographer and should therefore not change). The intended purpose of the interaction is a collection of commonly agreed-on principles that will guide the group, it's constituents and if possible, all others. (Scheele, 1975)

3.3 Overview of the Delphi technique

This section will deal with Delphi technique with respect to its origin, characteristics and classifications and the process and requirements of the Delphi research process.

3.3.1 Origins of the Delphi Research Process

The Delphi technique is a method for collection of expert opinion on a particular topic by way of structuring a communication process between a group of experts. The main aim of the original study was to gain consensus of opinion of a group of experts using a series of questionnaires together with controlled feedback. The Delphi concept originated from military defence research in the early 1950's and was devised by Helmer and Dalkey when working for the RAND Corporation as a tool for determining military priorities. The technique is named from Greek mythology; the Oracle of Delphi, which was believed to have accurately predicted the future (Linstone & Turoff, 1975; Jones & Hunter, 2000; Reid, 1993; Goodman, 1987; Clayton, 1997).

Many varieties of the Delphi technique exist (Linstone & Turoff, 1975). Goodman (1987) in her review of 150 studies using the Delphi commented that it was difficult to arrive at a definite universally agreed working definition of Delphi and that may variations of the original Delphi procedure existed. Crisp, Pelletier, Duffield, Adams & Nagy (1997) in their methodological review of the Delphi came to the same conclusions on the application of the Delphi. They all however agree that Delphi is an effective method for conducting group communication in order to deal with complex problems or in the case of this study, to get consensus on clinical competencies required by newly qualified diagnostic radiographers.

3.3.2 Distinctive features of the Delphi communication process

The Delphi technique is a structured communication process with the following distinctive features:

- There is feedback of individual contributions;
- Some form of collation of the groups view is presented;
- There is an opportunity for panellists to revise their view; and
- Anonymity for the panellists is assured (Linstone & Turoff, 1975; Loughlin & Moore, 1979).

3.3.3 Reported uses of the Delphi technique

The Delphi technique has classically been used as a forecasting procedure while some of the other documented uses are for:

- historical studies
- budget allocations
- urban and regional planning options
- curriculum development
- putting together the structure of a model
- identifying features of effective in-service practices
- identifying competencies
- vocational training (Linstone & Turoff, 1975; Clayton, 1997)

3.3.4 Guidelines for the application of the Delphi technique

The appropriate use of this technique is not around the nature of the application, but whether the particular circumstances require a group communication process (Linstone & Turoff, 1975). The key is thus whether this is the correct or appropriate method and who is recruited to partake in the communication process (in other words the panel members). The Delphi technique therefore requires a research focus, a panel of experts and a series of well developed questionnaires.

3.3.4.1 The research focus

Careful consideration of the problem to be researched is paramount as the Delphi technique is a justifiable method if a group communication process is what is needed to answer the research questions (Sackman, 1975; Linstone & Turoff 1975; Hasson, Keeney & McKenna, 2000). The aim of this research is to obtain consensus nationally on the clinical

competency requirements of newly qualified diagnostic radiographers. Jones and Hunter (2000) comment that the most appropriate use of the Delphi is where opinions are being sought when little or no evidence exists. McKenna concludes,

> "...the main advantage of 'Delphi' is the achievement of concurrence in a given area where none previously existed" (1994:1222).

This research project therefore used a group communication process (the conventional Delphi technique) by recruiting a national panel of radiography experts who gave their opinions, via three rounds of successive descriptive questionnaires on the clinical competencies required of newly qualified radiographers. The Delphi technique thus enabled a group of experts from different geographical locations throughout the republic of South Africa, to communicate their opinions in confidence without the pressure or persuasion of other panellists (Jones & Hunter, 1995). Other methods employed in order to answer the research questions, such as a meeting, can inhibit individuals from being entirely honest because they may feel intimidated by other individuals in the meeting (Jones & Hunter, 1995). The Delphi technique is thus a cost effective method for structuring a group communication process nationally.

In summary, the following are guidelines for applying the Delphi technique:

1. If the problem does not need to be subjected to analytical techniques, but rather collective opinions.
2. There has not been any prior adequate communication.
3. A face to face meeting is difficult for the following reasons:
    - the numbers of panellists able to effectively communicate;

- time and costs to mobilize frequent group meetings;
- to improve the efficacy of a face to face meeting;
- where individuals feel threatened by other panellists;
- where disagreements amongst panellists is so severe resulting in arbitration of the communication process (Linstone & Turoff, 1975).

The advantage of this method over a committee or decision making group is that panellists are not intimidated by or dominated by one individual or groups with vested interests or hierarchical structures (as frequently found in the structure of Health Professionals) (Jones & Hunter, 1995; Williams & Webb, 1994).

3.3.4.2 Sample selection

The selection of an expert panel is what makes a Delphi study unique from any other survey research (Clayton, 1997; De Villiers, De Villiers & Kent, 2005; Goodman, 1987; Jones & Hunter, 1995). There are no absolute rules as to who should be invited onto the panel, except that there must be some validation of the selected persons as having an authority in the research focus area (Jones & Hunter, 1995). The originators of the Delphi do not support a random sampling of panellists, but rather the use of experts or at least informed individuals (Goodman, 1987). The nature of the problem under investigation also influences the panel selection (Goodman, 1987). Goodman (1987) supports Linstone and Turoff (1975) and Sackman (1975) with reference to purposive selection of the expert panel if they are representative of the group or area of knowledge under study. The researcher has to be accountable for the selection procedures used (Goodman, 1987).

The strength and content validity of the Delphi supposedly lies in the selection of the expert panel, but Goodman (1987), Linstone and Turoff (1975), Sackman (1975) and Hasson *et al.*, (2000) all agree that how an expert is defined in a contentious issue.

Williams and Webb (1994) commented that the four studies that they reviewed applied certain selection criteria for panel selection. They concluded that when the Delphi is used to specify the components of professional effectiveness, the method has high face and content validity because in their study, the experts were selected by specific criteria and their opinions were current.

Boath, Mucklow & Black (1997) reported issuing a questionnaire to the prospective panel asking them about their qualifications and type of clinical practice. This in my opinion would help to address the definition of the expert which the authors above find 'arbitary' and thus secure the content validity of a Delphi study. "Representation" on the panel is another contentious issue raised by Boath *et al.*, (1997). They considered whether their panel should have included student representation (the target learner group). They subsequently decided that it was unnecessary as the validity of the Delphi is reliant upon experienced members of the profession. In the case of this research, the professionals on the panel have at some stage been the target learner group themselves. Hasson *et al.*,(2000) describes a multistage process in the identification and selection of a panel which had to meet certain criteria. The process involved a negotiation of access to information regarding potential participants whereby gatekeepers (Boath, Mucklow & Black, 1997) were needed

to nominate individuals who were suitable for the panel. Once potential panellists were identified, they were invited to participate.

The size of the panel is another consideration. From the literature reviewed, it is evident that there are no definite rules that can be applied to determine sample size generally in the research process (Brink, 2000) and specifically to the Delphi technique (Fink, Kosecoff, Chassin & Brook, 1984; Williams & Webb 1994, Crisp *et al.*, 1997), however the purpose, design and sample used are guiding factors (Brink, 2000;). While it is often stated that the larger the sample the better, this is true up to a point for quantitative studies and not applicable to qualitative studies. This is particularly true when a purposive sampling technique is employed (Brink, 2000) (as is the case in this research). Brink (2000) comments in her review of the literature that sample sizes smaller than 30 in qualitative studies increase the likelihood of individual meanings and factors such as the carefulness in the construction of the research tool and the number of variables in the sample population are important considerations in the sample size. There is however agreement amongst researchers that there should be a minimum of 10 subjects per variable in the sample although 30 is preferable.

There appears to be variety in panel size from one Delphi study to another and there seems to be no recommendations for sample size in Health studies (Williams & Webb, 1994). Reid's (1988) review of Delphi panel sizes in health studies showed a variation from 10 to 1685 panellists. Panel sizes seem to vary depending on factors such as the purpose of the study, available resources, expertise required and manageability (Fink *et al.*,1984; Clayton,

1997; Crisp *et al.*, 1997)). A rule of thumb is 15-30 panellists when coming from the same discipline (e.g. radiography) (Clayton, 1997). The size of the panel can affect the follow-up response rate thereby subjecting the results to response bias and for this reason, it is important to closely monitor attrition rates over successive rounds to ensure that the range of expert opinion is adequately represented (Williams & Webb, 1994).

3.3.4.3 Questionnaire design

De Vaus (1999) explains that when designing questions, one needs to consider what type of information needs to be elicited. They suggest that there are five main types of question content: behaviour, beliefs, attitudes, knowledge, and attributes. Their definition of "attitude" questions are those designed to discover what respondents think is "desirable" while "attribute" questions are designed to obtain information about the respondent's characteristics. When measuring attitudes and beliefs, three different aspects of measurement exist namely; direction, intensity and extremity (de Vaus, 1999). Direction indicates whether the respondent agrees or disagrees. Intensity indicates the degree to which they hold that attitude, namely do they agree or strongly agree? The questionnaire design must be based on whether one wants to measure direction, intensity or extremity (or some combination) (de Vaus, 1999).

Typically in a Delphi study, consensus is reached via three rounds of descriptive questionnaires, which are sequentially interspersed with iteration and controlled feedback (Hasson *et al.*; 2000; Reid, 1993; Boath, 1997; McKenna, 1994). The questionnaires need

to be systematically designed with careful consideration for item construction (Sackman, 1975).

Some studies reported the use of an open-ended questionnaire for the first round. There are two options for developing the first round questionnaire, namely a research team which pools ideas after studying the literature or an open-ended questionnaire to a group of experts (De Villiers *et al.*, 2005).

The length and complexity of the questionnaire may influence the response rate (De Villiers *et al.*, 2005). McKenna (1994) reports from his literature research that there have been numerous modifications of the basic Delphi technique. One adaptation of the technique he refers to is the 'reactive Delphi' which involves asking panellists to react to information prepared previously rather than to generate lists of items. McKenna (1994) does however caution that too much modification without ensuring rigour may compromise the legitimacy of the research. As the researcher this implies that one would have to be clear how the items were derived for the first round of the questionnaire.

An initial questionnaire may also collect qualitative comments which are then sent back to participants in a quantitative form through a second questionnaire (Powell, 2003). Powel (2003) comments from her study of the literature, that the first round questionnaire is usually open-ended as open-ended questions are seen to provide more food for thought. This thought is echoed by Boath *et al.*, (1997) in their study which used an interview in the first round which asked very broad questions with the intention of "... encouraging

respondents to put forward their own ideas, views and opinions without any encouragement or restrictions". However, a variety of alternative approaches are used from semi-structured to structured questionnaires in the first round (Powel, 2003). There has been some criticism of these structured questionnaires as the items offered may have researcher bias which could influence the results of the study (Powel, 2003).

3.3.5 Classification of Delphi

There are three types of Delphi techniques, namely;

- *Conventional:* Questionnaires are sent out to "experts" to gauge their support; usually 3 rounds, where the results of the 1st questionnaire are used as a basis for subsequent rounds.
- *Real-time or modified:* Shorter form; the process occurs during a meeting with immediate summary of results.
- *Policy:* a forum for ideas where experts present options and the convener makes a decision (Linstone & Turoff, 1975; Jones & Hunter, 1995; Hasson *et al.*, 2000).

3.3.6 Limitations of the Delphi technique

In this section I will discuss the reliability and validity issues that affect the application of the Delphi technique. This is followed by a discussion on the issue of consensus and finally I highlight the possible reasons for the failure of the Delphi technique.

3.3.6.1 Reliability and validity issues

With reference to the literature review, the reliability and validity of the Delphi rests on the following issues; the appropriateness of the Delphi technique to the research focus, the questionnaire construction, the selection of the expert panel, definition of an expert, the reproducibility of the results, the definition of consensus and the transferability of the results (Clayton, 1997; McKenna, 1994). The suitability of the Delphi technique has already been discussed with reference to its advantage for a group communication process nationally. The expert panel has been defined and purposely selected to represent radiography in South Africa. An attempt was made to maintain this representivity throughout all the rounds of the questionnaire (Hasson *et al.*, 2000) by communicating with the panellists to encourage them to return their responses. It was felt that by maintaining the panel's representation (refer to Figure 3.1), the reproducibility and transferability of the results would be increased. This constant communication with panellists supports McKenna's (1994) theory that the panellists appreciate the "personal touch".

3.3.6.2 The issue of consensus

The Delphi technique is an example of empirical research and the guarantor of its validity is consensus of opinion by a group of experts (Scheele 1975). The definition of consensus is a contentious issue and often poorly explained in many studies (Crisp *et al.*, 1997; Williams & Webb, 1994). Murry and Hammons (1995) define consensus as a gathering around median responses with minimal divergence. Jones and Hunter (1995) describe the aim of consensus methods as the extent to which people agree about a given issue.

The advice of Crisp *et al.*,(1997) is thus valuable when they suggest that the researcher should establish the place of consensus and then conceptualize it at the start of the study. Their review of the literature on this issue varies from arguments that consensus obtained in the Delphi is not related to agreement (drawing on the work of Sackman, 1994; Woudenberg, 1991) to the most common position that consensus is the most important goal of the method. Consideration must also be given to the level of consensus to be employed (Hasson *et al.*, (2000). There does not seem to be a commonly agreed percentage indicating consensus and issues such as sample numbers, aims of the research and resources influence consensus levels (Hasson *et al.*,2000). Sumsion (1998) recommends defining consensus as >75% agreement by the panel for each clinical competency before the data is analysed. In the study conducted by Loughlin K and Moore L (1979) to establish fitting objectives and activities in a paediatric department, 51% agreement amongst respondents was deemed consensus.

The researcher took the advice of Côtè and Turgeon (2005) and Crisp *et al.*, (1997) and defined consensus before data collection commenced. Consensus was thus set at >75% for each clinical competency to be included as a necessary clinical competency for newly qualified radiographers for this research. The results of the first round questionnaire achieved consensus on 86% of the clinical competencies expected of a newly qualified radiographer.

The Delphi technique is not only effective for deriving consensus, but also useful for indicating areas where there is no obvious consensus (Loughlin & Moore, 1979). The

stability of the panellists responses over successive rounds (refer to Table 4.14, page 113, Table 4.19, page 123 and Table 4.21, 124) as discussed by Crisp *et al.*, (1997) should receive attention in terms of suggestions for further areas of research. With reference to this research, consensus is one of the aims of the research; however the research also aims to identify certain general principles with regard to the interpretation of the intended SAQA outcomes and the position of radiographers on "role extension".

Goodman (1987) drawing on the work of Sackman (1975) and Scheibe *et al.*, (1975) criticizes the Delphi because it stifles independent judgement. They argue that one should take into account the response distributions because like Crisp *et al.*,(1997) drawing on Dajani *et al's.*, (1979) work suggests, the stability of the panellists response to an item over successive rounds should receive attention. The final judgements of the results should take into account the distribution of responses (Sackman, 1975).

3.3.6.3 Reasons for failure of the Delphi technique

The Delphi may fail for the following reasons:

- not allowing panellists to express their own views. This can occur if questionnaires are over structured;
- applying the Delphi inappropriately;
- poor techniques of summarising the group's response;

- not presenting and investigating disagreements and new ideas thereby alienating panellists. This may have the effect of increasing drop-outs rates resulting in an artificial consensus; and
- not recognizing the time and effort taken by the panellists (Linstone & Turoff, 1975).

There are also other virtual problems such as the selection of a reliable panel, the ability to adapt the Delphi design to the problem under investigation and finally the honesty of the panellists. Language differences and logic of the panellists may also influence the process (Linstone & Turoff, 1975). As the researcher one has to endeavour to keep the communication process efficient and fair and achieve a balance between how to ask the questions and how to summarise the questions.

The Delphi communication process does not allow one insight into the emotional aspect of communication as one is not able to see for example gestures or hear the tone of voice of the respondent (Linstone & Turoff, 1975).

3.4 Research design: The application of the Delphi technique to this research focus

I now turn to discuss the application of the Delphi technique to this research. I describe the research questions and explain the relevance of the Delphi technique in answering the research questions. The specific data-gathering and data analysis procedures are then explained, and the ethical issues arising from this research are given consideration.

The research design was guided by the following research questions:

1. What is expected of new radiography graduates in the workplace?

   This question is the main focus of this research. The Delphi process and analysis of the results have provided the clinical competencies required of newly qualified diagnostic radiographers.

2. Is there a gap between the clinical curriculum and performance skills?

   The data gathered from the first research question was used to do a categorical analysis between the opinions of radiography academics and clinical practitioners.

3. What are the implications of the clinical competencies identified for benchmarking undergraduate assessment practices?

   The consensus on the clinical competencies (research question one) and the implications of the results of the categorical analysis (research question 2) were considered in the development of a new model of assessment for clinical performance.

This research design generated data on the consensus of opinion on clinical competencies as well as data on areas of divergent opinion. An overview of the research design is depicted in Table 3.3 below (Hasson, Keeney & McKenna, 2000).

Table 3.3: Issues for discussion regarding the Delphi methodology

Data collection:	Clear explanation of the Delphi method
Rounds:	Number employed, outline of each
Sample:	Expert's selection process and characteristics described in detail
Reliability and validity issues:	Identified and explained
Statistical interpretation:	Guidelines for the reader
Ethical responsibilities:	Towards the expert sample and the research community

3.4.1 The Delphi technique and professional competence

The Delphi technique has proved to be successful in identifying professional competencies and has frequently been used in curriculum planning (Dunn et al., 1985; Syme-Grant, Stewart,& Ker 2005; Jones & Hunter, 2000).

The aim of this research was to get consensus of opinion on the clinical competencies required of newly qualified radiographers. With reference to de Vaus (1999), the successive rounds of questionnaires employed in this technique seek to measure the direction and intensity of the responses. Because the nature of the Delphi is such that it is an iterative process with controlled feedback, the extreme responses were investigated in order to establish clarity of opinions.

Jones and Hunter (2000) consider the Delphi technique useful for defining the clinical capabilities expected of health professionals. With reference to the clinical competencies that this research aims to identify, the six stated exit level outcomes [9] that have interim registration with SAQA, were used as starting point. The purpose statement, exit level outcomes, specified outcomes and assessment criteria were developed by various stakeholders during various rounds of enface meetings (what Linstone and Turoff (1975) classify as "policy" type Delphi). These broad outcomes were open to interpretation by curriculum designers, and in order to design a clinical curriculum from those broad outcomes, one has to develop clinical competency statements. Interpretation of these outcomes happened at institutional level without further national collaboration. For

[9] Refer to page 4 for the stated outcomes.

example the CCFO [10], "Communicating effectively in the learning and health care environment" is open to various interpretations. It is the interpretation of these outcomes that will define the clinical curriculum, and the resultant clinical competencies. This research hopes to identify gaps in the interpretation, and seeks to develop a guideline for national standards of clinical competency. Consensus on the clinical competencies from a collaborative group of radiography experts, using a conventional Delphi process, will facilitate uniform understanding and interpretation of core clinical competencies.

To answer the second research question on whether the clinical curriculum adequately prepares the student radiographer for the workplace requirements, a non-probability sampling was chosen. The reason why a non-probability sampling technique was chosen was to select those subjects who know the most about a phenomenon and who can explain nuances to the researcher (Brink, 2000; Schofield & Jamieson, 1999). The phenomena and nuances, with reference to clinical radiography will thus be highlighted by a sample of experts comprising both academics and clinical practitioners. Within the clinical environment, nuances such as the hierarchy within the clinical department may account for differing opinions between academics and clinical practitioners. The Delphi technique has also been used successfully for setting standards in nursing educational research (McKenna, 1994).

In summary, the Delphi technique was used in this study to elicit information and judgements from expert participants to facilitate decisions on the clinical competencies required by newly qualified diagnostic radiographers (Dunham 1998). Jones and Hunter

[10] Refer to page 5 for a list of all the Critical Cross-field Outcomes.

(1999) cite the Delphi technique as one of the formal consensus methods commonly used in health services research. They view it as a method that maximizes the benefits of input from experts in the field. The Delphi technique is relevant to this study because it has the following advantages as described by Fraser (1999):

- It guarantees anonymity of all participants;
- It provides repetition and controlled feedback of information. This is achieved by using successive questionnaires that incorporate information and opinions regarding the clinical competencies required so that these may be entered into the practice domains model (Melnick *et al.*; 2002) from one round to the next. This is a valuable process because it enables all participants to be informed of the respondents' opinions even if they did not respond themselves;
- It enables a group response to be represented statistically;
- It uses experts to participate in the study;
- It encourages participants to give opinion without feeling intimidated by others or by more assertive persons; and
- It provides relevant information because the Delphi process is cyclical with respect to the dissemination and amendment of individual opinions in order to reach a group consensus.

If consensus can be reached, then the acceptance and thus implementation of these guidelines for the development of defensible standards which would inform the undergraduate assessment of clinical practice is more likely to be successful. However, if consensus, in terms of majority view, was not achieved, then radiography practitioners

would know the range of views and this may assist them to achieve compromise if not consensus.

3.4.2 Data collection method

In this section, issues regarding the questionnaire design, administration and data collection procedure are discussed.

3.4.2.1 Questionnaire design

Each of the three rounds of questionnaires (see appendices E, G and I) employed in this research project had an introductory statement which described the purpose of the questionnaire thereby distinguishing for the panellists, what the target group under investigation were (Polgar & Thomas, 2000; de Vaus, 1999). The introductory statement on the questionnaire stipulated to the panellists that the clinical competency requirements were for newly qualified radiographers within three months of qualifying. Williams and Berry (1999) in their study which investigated competencies for the radiographer, asked their panel to consider at what point in time after qualification the radiographer should be expected to be competent. The response by 61% of the panel suggested between 1 and 3 months. The panel commented that the time scale for expected competency could vary depending on whether the graduate was employed at the same clinical platform that they had received their undergraduate clinical education. Graduates who were employed at the clinical platforms where they worked as student radiographers would be familiar with these departments and would thus need less time to adapt than graduates who were employed at clinical platforms other than where they trained. For purposes of this research, a newly

qualified diagnostic radiographer was defined as a radiographer with less than three months of experience. This time frame is necessary in order to "dimensionalize" the concept or provide a "frame of reference" (De Vaus 1999).

Panellists were also required to provide their biographical details such as where they were employed and where their expertise lay. This was necessary to enable a categorical analysis of the data with reference to whether there would be statistically significant differences of opinion between academics and clinical for example. This information also gave insight into the representivity of the panel.

The successive rounds of questionnaires sought to measure the direction and intensity of the responses (de Vaus, 1999). Because the nature of the Delphi is such that it is an iterative process with controlled feedback, the extremity of the responses was also investigated in order to establish clarity of opinions.

All three rounds of questionnaire were based on a closed questionnaire construction where respondents were provided with a list of clinical competencies which they had to rate. The option for a more structured 1st round (appendix E) was chosen because the SAQA outcomes were already developed using a nominal group technique in 1999. The statements of clinical competencies in this research were relevant because they were based on the clinical competencies derived from the SAQA outcomes as well as a literature review on the clinical competency requirements of new graduates (Akroyd & Wold, 1996; HPC of UK, 2003 and the American Registry of Technologists (Cavallin, 2006; Kowalczyk

& Mazal, 2006). This technique employed for the first round may be likened to the 'reactive Delphi' as described by McKenna (1994). A literature review was also undertaken to investigate role extension opportunities for diagnostic radiographers and thus some of these competencies were included (Nightingale & Hogg, 2003; Akroyd & Wold, 1996). Six categories were developed based on the exit level outcomes of the 360 credit SAQA interim registration. The categories were: Technical skills and theoretical applications; Patient care and communication; Health and Safety; Management; Organisation and Administration and Professional. A total of 109 clinical competencies were constructed for the first round questionnaire.

The design of the questions of this study can be seen as "attribute" type questions because respondent's opinions were being sought (de Vaus, 1999). But respondents "beliefs"- what they think is true or false, were also manifested in the way they answered the questions. This issue was further explored in the interpretation of the results. The extremity of an attitude can also be measured, for example with reference to this research, a respondent may not be in favour of the newly qualified radiographer providing a written report on a trauma radiograph, which will differ from the person who believes that report writing should be restricted to post-graduate qualifications and then the person that believes only radiologists should report on radiographs.

The constructions of subsequent rounds were based on the analysis of the preceding round. A Likert scale was used in all three rounds (Powell, 2003; De Villiers, *et al.*, 2005; Sackman, 1975; Boath *et al.*, 1997). Panellists were provided with an opportunity to

provide a reason for their choice or to offer any additional comments (De Villiers, *et al.*, 2005; Boath *et al.*, 1997; Babbie & Mouton, 2001).

3.4.2.2 Likert rating scale

The Likert rating scale is widely used when measuring attitudes and involves giving respondents a statement that reflects a particular attitude or opinion (de Vaus 1999, Babbie & Mouton, 2001). Many varieties of Likert scales exist, but they all require the respondents to give one and only one response for each item. They are also suited to lists of items and they provide structured data which can be assigned numerical values for mathematical computation and statistical analysis (de Vaus 1999; Babbie and Mouton, 2001). Respondents rated their agreement or disagreement with the statement. Typically respondents were given alternatives of strongly agree, agree, neither agree, nor disagree, disagree and strongly agree. This approach de Vaus (1999) says can measure the direction, intensity and extremity (depending on the number of response categories).

A 4-point Likert scale in a "matrix" format was used for this study (de Vaus, 1999), namely:

1=strongly disagree	2=disagree	3=agree	4=strongly agree

This forced the panel members to offer an opinion because it did not allow the respondents to be non-commital (Polgar & Thomas, 2000). De Vaus (1999) drawing on the work of Rotter (1972) mentions that experts are not in agreement as to how many response categories should be provided. He suggests that 5-point scales provide a measure of intensity, extremity and direction. Longer scales, he suggests allow for greater

discrimination. De Vaus (1999) drawing on the work of (Converse & Presser; Bishop *et al.*,1990) suggests that one should allow for a "don't know" or "no opinion" response because to force the respondents to give their opinions, may be misleading. With reference to this research, we were asking "experts" to give their opinions on professional clinical competencies which define the profession of diagnostic radiography today and in the future and thus a "don't know" option was not warranted in this context.

3.4.3 Time frame

The table below (Table 3.4) summarises the time frame of the data-gathering process for the three rounds of questionnaires.

Table 3.4: Time-frame of the data-gathering process

	1	**2**	**3**	**4**	**5**	**6**
Start	**Feb-Mar 2005**	**Mar-Apr 2005**	**May 2005**	**Jun 2005**	**Aug 2005**	**Sept 2005**
Task	Design of 1st round questionnaire	Panel recruited	1st round questionnaire piloted	1st round questionnaire sent out	Data captured of 1st round questionnaire	1st round questionnaire analysed
	7	**8**	**9**	**10**	**11**	
Start	**Oct 2005**	**Nov 2005-Feb 2006**	**May 2006**	**Jun 2006**	**Aug 2006**	
Task	2nd round questionnaire designed and sent out	Data captured of 2nd round questionnaire	3rd round questionnaire piloted	3rd round questionnaire sent out	Data captured of 3rd round questionnaire and analysed	

3.4.4 Administration of the questionnaires

Before the questionnaires were sent out to participating panellists, they were piloted to check for; the clarity of the instructions, the ease of filling in the questionnaire, the time taken to complete the questionnaire and any general item analysis (Polgar & Thomas, 2000; Brink, 2000; Leedy, 1989).

A radiography manager and a radiography academic were asked to pilot the questionnaire. The results of the piloting process uncovered some ambiguity in the competency statements which needed re-wording. The 2nd questionnaire (appendix G) was not piloted. It is acknowledged that neglecting to pilot this questionnaire may have resulted in the construction and wording of some of the clinical competencies being unclear (particularly section B4). This became evident in the analysis of the questionnaire. The same radiography manager and radiography academic were asked to pilot the 3rd round questionnaire (appendix I). Minor changes were made to the wording of some of the competencies. Both felt that the statement of the research aims was clear.

The average time taken to complete the questionnaire was 25 minutes. One panel member wrote back to the researcher to ask for clarification on the issue of anonymity (as guaranteed by the consent form- appendix B1) because the questionnaire asked for their biographical details. The explanation given to the prospective panellists was that anonymity was assured amongst panellists and the need for biographical information was necessary in the event of the researcher needing to contact the panellist in order to obtain clarity of opinion if necessary and for follow-up purposes (Hasson *et al.*, 2000).

The results of the first round were collated by the researcher. The second round questionnaire (appendix G) built on the results of the first round. Only the items that did not achieve consensus in the first round were included in the subsequent rounds. This was explained to the panellists in a covering letter (appendix F). Any additional ideas (competencies) and comments emerging from the first round were included for rating by the rest of the panel in the second round questionnaire (Loughlin & Moore, 1979 ;

Goodman, 1987). The second round questionnaire (appendix G) then incorporated these comments using the same 4-point Likert scale. The same 4-point Likert scale was once again used for the 3rd round questionnaire (appendix I).

Some form of a statistical summary of the group's response was included so that the individual could see where their opinion lay in relation to that of the total group and change their score in view of the group's response if so desired (Goodman, 1987; Jones & Hunter 1995) (see appendix I, which indicates the groups response in percentage for individual clinical competencies from round 2). In round 3, panellists re-ranked their agreement and this was then summarized and assessed for degree of consensus. If an acceptable degree of consensus was obtained, the process ceased with the results being fed back to the panellists, or the 3rd round could be repeated if an acceptable degree of consensus was not achieved (Jones & Hunter, 1995). The process is ongoing until consensus is obtained or the law of diminishing returns sets in (Hasson *et al.*, 2000). The researcher can continue beyond 3 rounds, although there is a need to balance time, cost and possible panellist exhaustion (Powell, 2003).

3.4.5 Site selection and sampling

The population of this study are those involved in radiography education in South Africa. The sample (or study population) is a subgroup of the population that is representative in some way of the whole group (Llewellyn, Sullivan & Minichiello, 1999; Brink, 2000). The study population was a national sample of radiography experts who were representative of the radiography profession in South Africa (see Figure 3.3). The sample selected

represented members of the Society of Radiographers (Professional Body); the Health Professions Council of South Africa (Regulatory body), radiography practitioners from both the public and private sectors and educationalists.

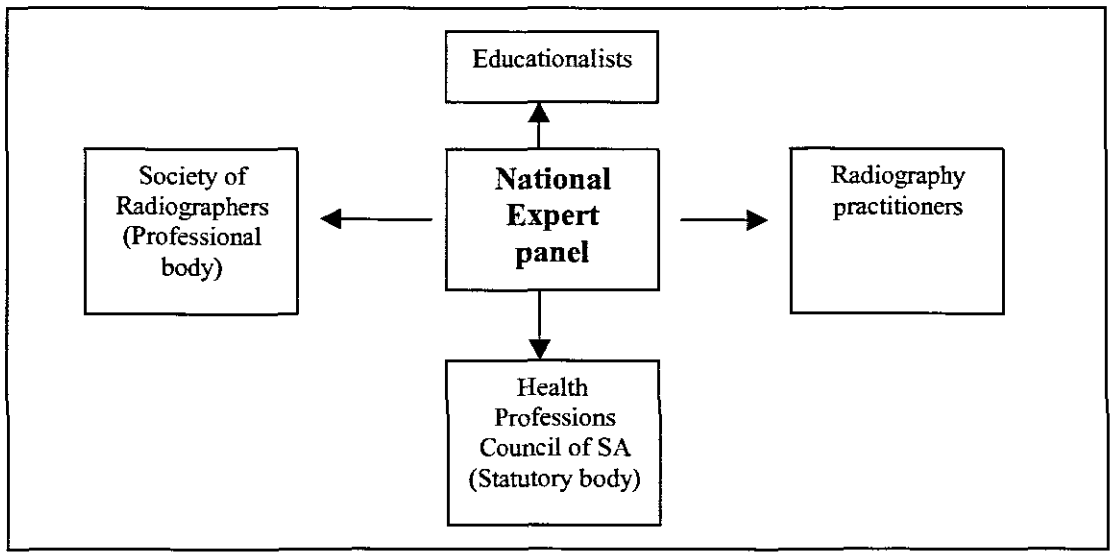

Figure 3.3: Representation of the study population

3.4.5.1 Criteria for selection of the panel

The experts on the panel were selected based on "inclusion" or "eligibility" criteria. This was necessary to ensure validity and transferability of the results (Brink, 2000; Hasson *et al.*, 2000). A "sampling frame" (Brink, 2000; Schofield & Jamieson, 1999) was prepared with the names of the Higher Educational Institutions in South Africa offering a diagnostic radiography qualification. A non-probability sampling technique was chosen because the Delphi technique requires the researcher to select those subjects who know the most about a phenomenon and who can communicate and explain nuances to the researcher (Brink, 2000; Schofield & Jamieson, 1999). A purposive sampling technique, a type of non-

probability sampling technique was applied in this study (Hasson *et al.*, 2000). Purposive sampling may also be termed "theoretical" or "judgemental" sampling. This method of sampling is based on the researcher choosing subjects who are particularly knowledgeable about the research question (Brink, 2000; Schofield & Jamieson, 1999). It is this expertise which is sought in the panel selection for this particular research. An advantage of purposive sampling is that it allows the researcher to carefully select the sample based on certain criteria Brink (2000). The disadvantage of this is that there is a potential for a sampling bias and the possibility that the sample is not representative of the population thus reducing the generalisability of the results (Brink, 2000; Schofield & Jamieson, 1999).

With reference to panel size, it was mentioned previously that there appeared to be no recommendations for Health studies (Williams & Webb, 1994), but a rule of thumb of 15-30 from the same discipline was recommended by Clayton (1997). For this research, it meant that there were a minimum of 10 for each category on the expert panel, namely: radiography academics, radiography practitioners, radiographers in the state sector and radiographers in the private sector.

3.4.5.2 Recruitment of the panel

The seven HEIs who offer a diagnostic radiography education were approached to participate in the study. This involved telephonically contacting the head of the schools of radiography at these institutions and explaining the nature of the research and asking them if their institutions would be willing to participate on the expert panel. Ethics approval for the study was granted (appendix A). All the invited HEIs agreed to participate in the study.

A letter (appendix B) explaining the research was then sent to the heads of the radiography program, together with a consent form and proof of the ethics approval (see appendix A). The heads of the radiography program were also asked to provide the names and contact details in the grid provided (appendix C) (similar to "gate-keepers" as described by Boath *et al.*, 1997) of the diagnostic radiography lecturers in their department and to nominate three practitioners from their clinical affiliations who had to meet certain criteria namely:

- Have an established clinical affiliation with the higher education institution;
- Be experienced assessors of clinical performance;
- Employ new graduates; and
- Supervise new graduates.

This is similar to what Brink (2000) and Llewellyn, Sullivan G & Minichiello (1999) refer to as a type of probability sampling known as "snowball-sampling" which involves the support of study subjects in obtaining other potential subjects. They caution though, that this method, whereby possible participants are suggested by existing participants may introduce a bias into the sampling as the existing participants may suggest participants that they know will share similar viewpoints.

A list of 61 prospective panellists was generated from the list supplied by the heads of the radiography departments at the HEIs. The composition of the initial nominated panel *(n=61)* is indicated below (Figure 3.4).

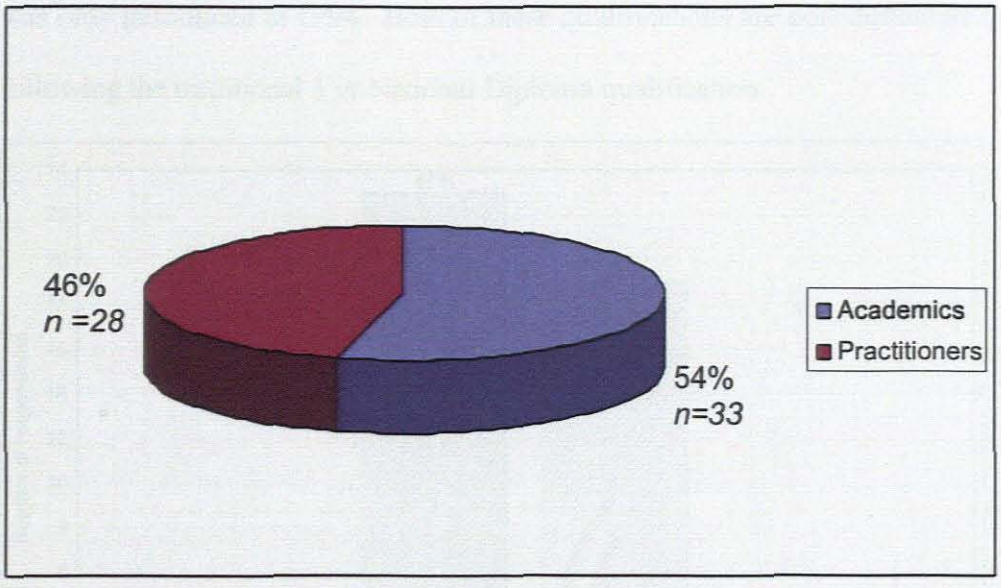

Figure 3.4: Initial recruited panel

Prospective panellists were contacted telephonically and invited to participate. The researcher was only able to make contact with 58 of the 61 panellists nominated. All were willing to participate. These panellists then each received a letter outlining the research and asking them to sign consent to participate in the study (see appendix D). Panellists were given the opportunity to communicate with the researcher either via the post or electronically depending on their preference (Hasson *et al.*, 2000).

3.4.5.3 Radiography qualifications of the panel

Figure 3.5 reflects the radiography qualifications of the panel for round 1. Forty seven percent (n=23) of the panellists had a Bachelor of Technology degree (B TECH) or equivalent Honours degree while 6% (n=3) of panellists held a National Higher Diploma in Radiography (NHD). The NHD can be considered equivalent to the B TECH degree which

was only introduced in 1994. Both of these qualifications are post diplomate qualifications following the traditional 3 yr National Diploma qualification.

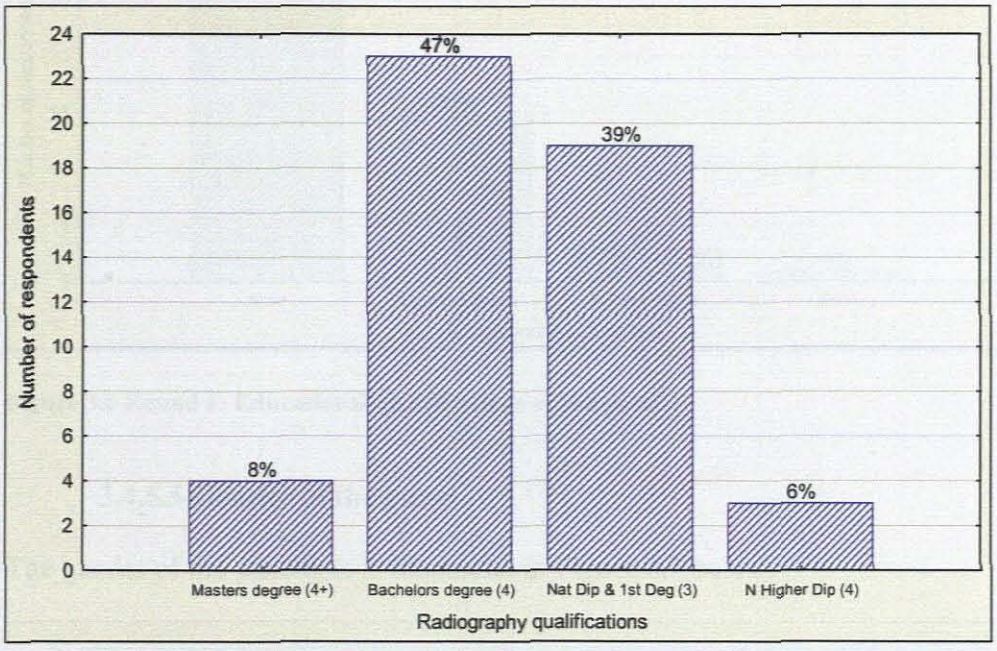

Figure 3.5 Round 1: Radiography qualifications of the panel.

Thirty nine percent (n=19) of the panellists were in possession of a National Diploma (ND) (offered by the Universities of Technology, previously know as the 'Technikons') or equivalent first degree offered by traditional Universities. The remaining 8% (n=4) of the panellists possessed Masters degrees.

3.4.5.4 Educational qualifications

Thirty nine percent of the panellists possessed a qualification in education as depicted below in Figure 3.6. Those with a qualification in education would be the academics employed by the HEIs.

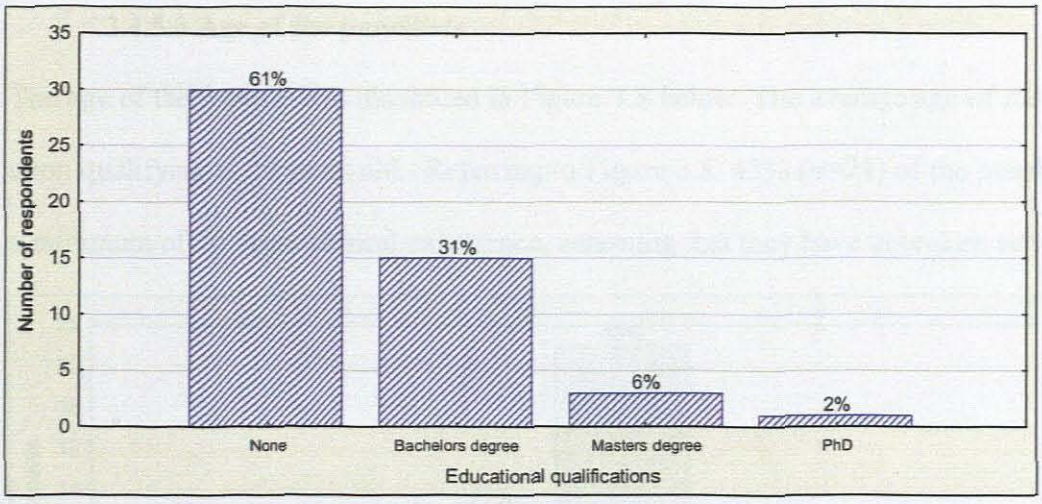

Figure 3.6 Round 1: Educational qualifications of the panel.

3.4.5.5 Gender of the panel

The gender of the panellists is illustrated in Figure 3.7 below.

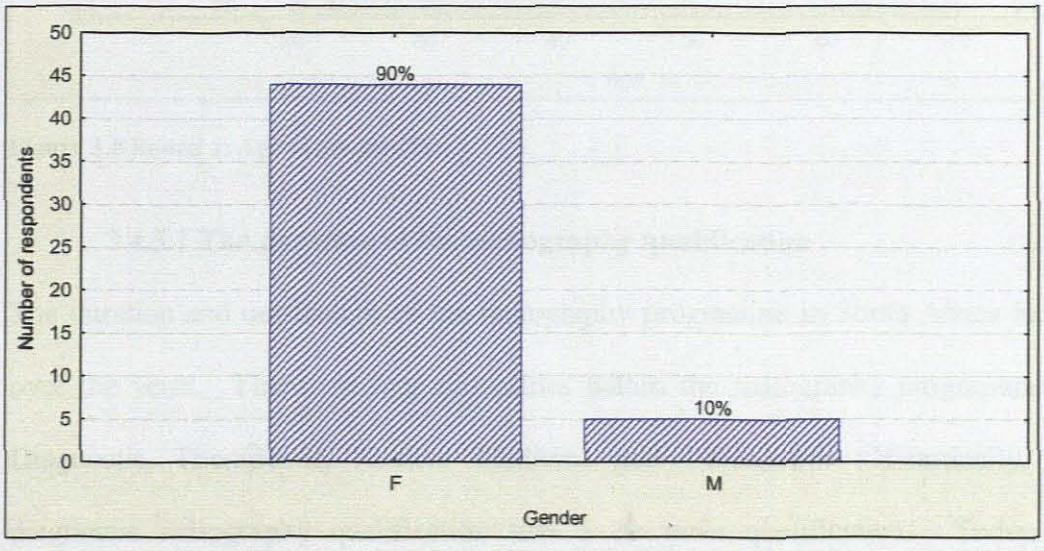

Figure 3.7 Round 1: Gender of the panel.

Radiography in South Africa remains a traditionally female dominated career. Ninety percent (n= 44) of the panellists were female, while 10% (n=5) were male.

3.4.5.6 Age of the panellists

The age of the panellists is illustrated in Figure 3.8 below. The average age of radiographer upon qualifying is 20 years old. Referring to Figure 3.8, 43% (n=21) of the panellists have a minimum of 20 years clinical experience, assuming that they have unbroken service.

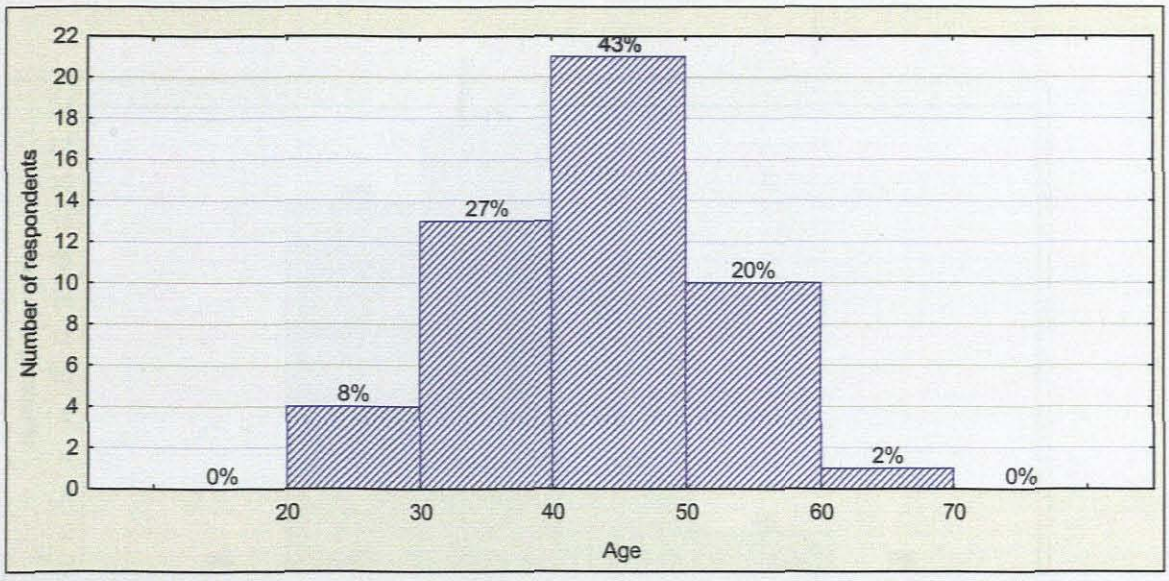

Figure 3.8 Round 1: Age of the panelists.

3.4.5.7 The duration of the radiography qualification

The duration and curriculum of the radiography programme in South Africa has evolved over the years. There are four disciplines within the radiography programme, namely; Diagnostic, Therapeutic, Nuclear Medicine and Ultrasound. Historically, only the diagnostic radiography qualification was a *de nova* qualification. Today, all four disciplines are mono-specialities. The duration of the national diploma also changed from a 2 year diploma prior to 1976 to become a 3 year diploma from 1977. The curriculum changes have seen a swing from a subject based system to an Outcomes Based Education in 2001, with the first graduates of the OBE graduating at the end of 2003. This change was

in line with the national policy changes and the National Qualifications Framework, bringing all learning under a single framework of outcomes-based standards and qualifications. Figure 3.9 indicates that 86% of the panellists hold a radiography qualification obtained prior to 1995.

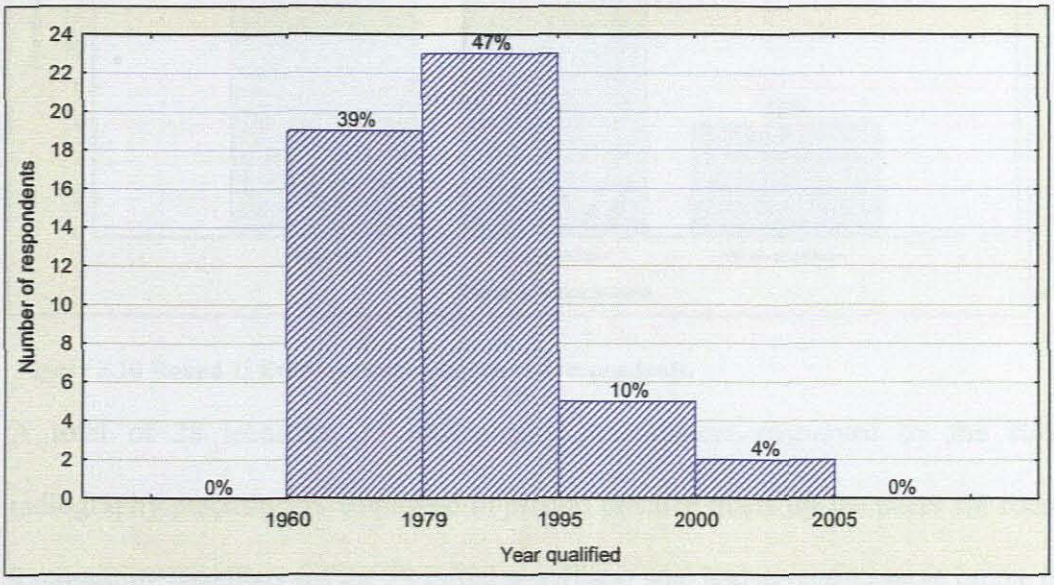

Figure 3.9 Round 1: Time of radiography qualification

3.4.6 Response rates of the recruited panel

3.4.6.1 Round one

The response rate of round one was 84% (n=49). The composition of the panel in respect of employment category for round one is illustrated by the histogram below (Figure 3.10).

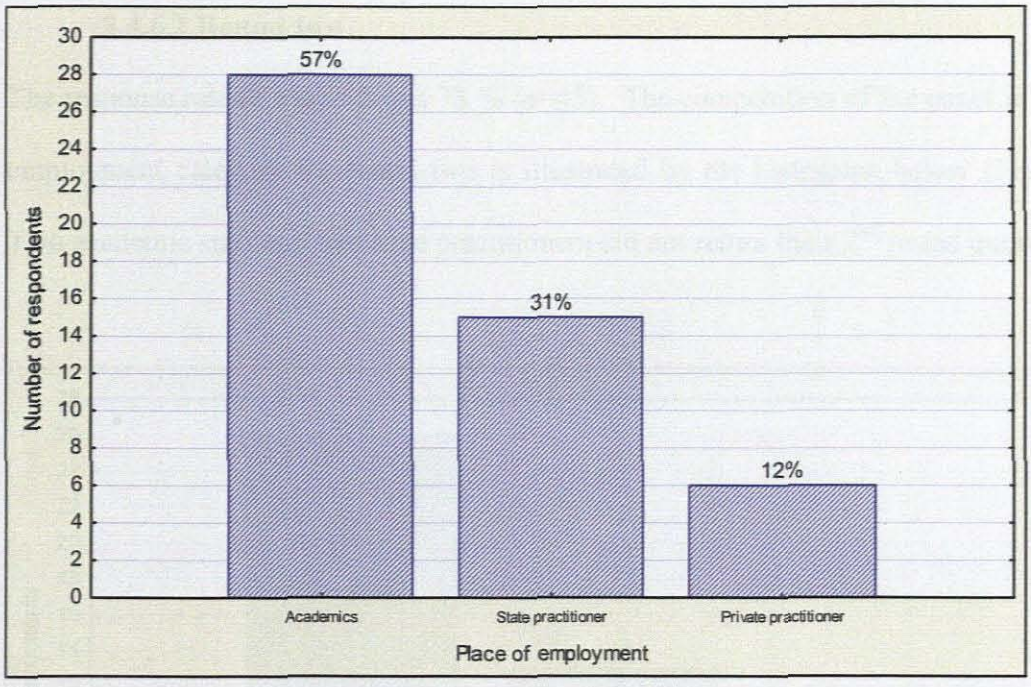

Figure 3.10 Round 1: Employment categories of respondents.

A total of 28 lecturers, 15 radiography practitioners employed by the state and 6 radiography practitioners employed in private practice made up the panel for round 1. The 9 remaining panellists (of the 58 initial panellists) who had agreed to serve on the panel, but did not respond to the first round questionnaire were followed up firstly via email and then telephonically. One of the prospective panellists from a private practice replied that after consideration, she declined to serve on the panel as their practice did not employ newly qualified radiographers. Two other panellists returned their responses after the analysis of round 1 was completed and therefore could not be included. They were informed in writing and were excluded from successive rounds. The other 6 panellists who did not respond after follow-up were also not included in the second round.

3.4.6.2 Round two

The response rate of round 2 was 78 % (n=45). The composition of the panel in respect of employment category for round two is illustrated by the histogram below (Figure 3.11). Two academic staff and two state practitioners did not return their 2nd round questionnaires.

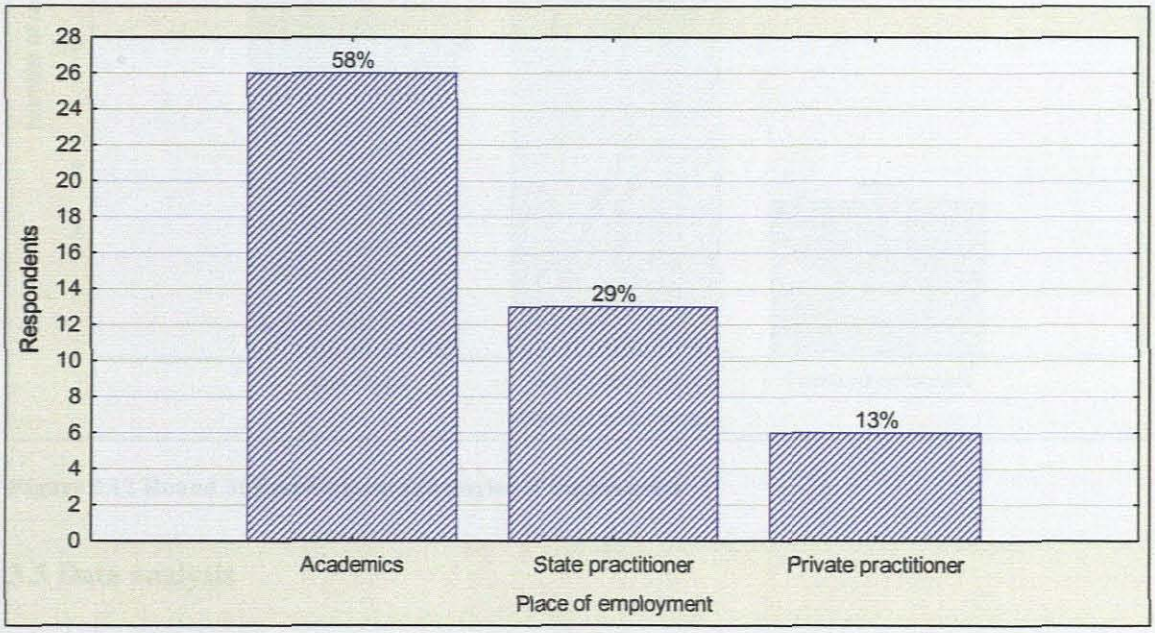

Figure 3.11 Round 2: Employment category of respondents.

3.4.6.3 Round three

The response rate for round 3 was 69% (n =40). The composition of the panel in respect of employment category for round 3 is illustrated by the histogram below (Figure 3.12)

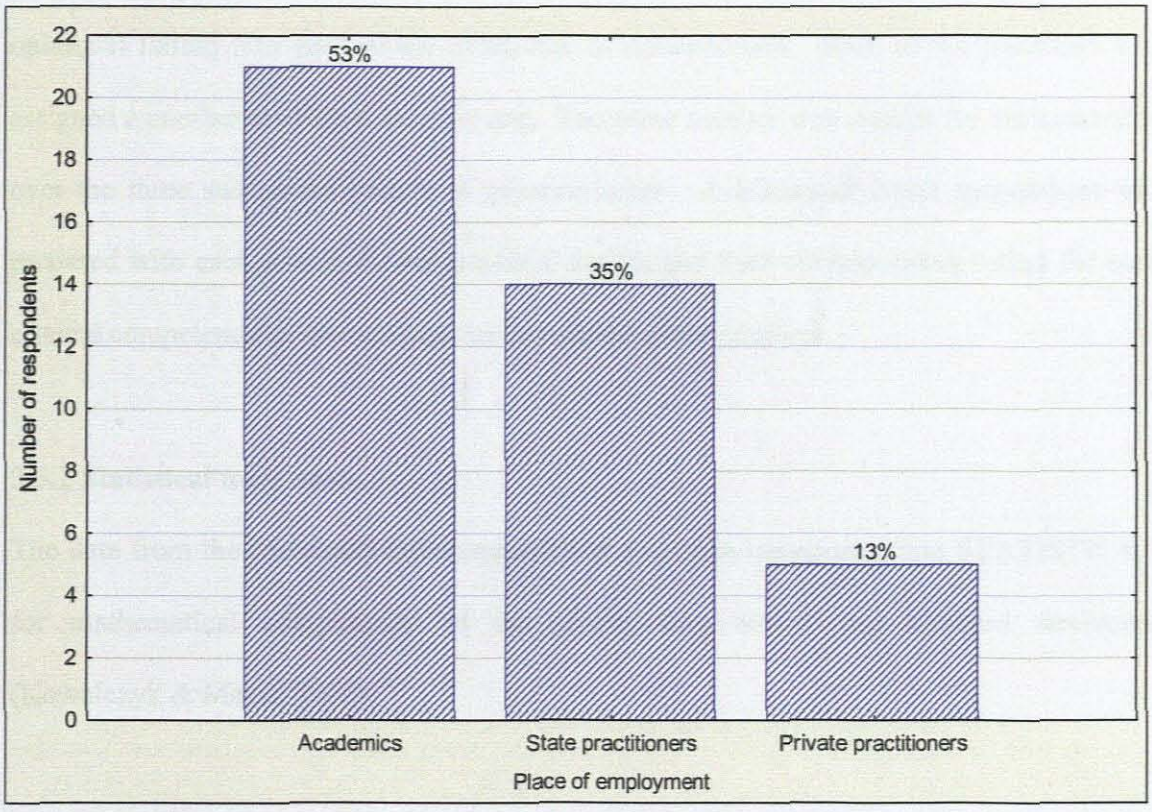

Figure 3.12 Round 3: Employment categories of respondents

3.5 Data analysis

In this section, I will first discuss the preparatory procedures for the statistical analysis, thereafter; I will describe the statistical tools used. A description of the statistical tests performed will then be outlined.

3.5.1 Preparatory procedures for statistical analysis

All three questionnaires had a 4-point Likert scale on which the panellists had to rate their opinions of the clinical competency requirements of the newly qualified diagnostic radiographers. This type of scale is referred to as ordinal or ranked scale and the organisation of the data involved counting the number of cases (in this study, the number of

opinions) falling into each of the categories of measurement. Each of the panellists was assigned a number starting at number one. The same number was applied for each panellist over the three successive rounds of questionnaires. A Microsoft Excel spreadsheet was prepared with each panellist's biographical details and their corresponding rating for each clinical competency as recorded on the completed questionnaires.

3.5.2 Statistical tools used

The data from the Microsoft Excel spreadsheet was then transported into STATISTICA 7 for mathematical computation of the results into means and standard deviations (Kowalczyk & Mazal, 2006).

Appropriate statistical measures for consensus are measures of central tendency and dispersion (Polgar & Thomas, 2000). Measures of central tendency are statistics which express the most typical scores in a distribution while measures of dispersion are statistics that express the extent to which the scores are spread out numerically. The measures of central tendency are the: mode, median and the mean. The mode is described as the most frequently occurring score in the distribution. The median is the score that divides the distribution into half, half of the scores fall under the median and half above the median (i.e. the middle score). The mean is the sum of all the scores divided by the number of scores (the average score) (Polgar & Thomas 2000; Unsworth, 1999).

Measurement of the "mean" for each clinical competency was selected for this research because with reference to consensus of opinion, the mean score takes into account the

"outliers" scores as well and is thus more accurate in this context than the median for example, which is not sensitive to outlier responses (Dunn & Clarke, 1974). The standard deviation is a measure of dispersion (Polgar & Thomas, 2000). With reference to this research, the larger the standard deviation, the more uncertain respondents were about a particular clinical competency (i.e. the greater the divergence of opinion).

3.5.3 Statistical analysis performed

The questionnaires produced both quantitative and qualitative data. [11]

3.5.3.1 Analysis of quantitative data

When the mean score of each individual competency was >3 (>75%), this was taken as consensus of opinion that those competencies were required of newly qualified radiographers. A mean of <2 indicated agreement that that competency was not expected of a newly qualified radiographer. When the mean of the scores ranged between ≥2≤3, this indicated divergence of opinion.

A categorical analysis was done on the biographical information to compare the opinions of radiography academics and radiography practitioners as well as the opinions of clinical practitioners employed in the state versus the private sector. Because the data was not normally distributed around the separate means, the Mann-Whitney test was conducted to see if there are significant differences in responses (Dunn & Clarke, 1974). A p value ≤0.05 was recorded as being statistically significant.

[11] Refer to table 3.5, page 96 for a summary of the research methodology

3.5.3.2 Analysis of qualitative data

Qualitative data was produced from the "free form" responses with reference to general comments and additional clinical competencies suggested by the panellists. The researcher then needed to explore these comments/statements to look for recurring themes such as duplication, ambiguity, unsuitable/unachievable for newly qualified radiographers and the likes. A thematic analysis was undertaken of the qualitative data. The following themes were used:

- Unfamiliar terms needing to be defined;
- The need for a stricter definition of a term; and
- Defining the extent or level of clinical practice.

In the second and third rounds of the questionnaire (see appendices E & G), items were re-phrased in order to achieve clarity on the above. The responses of the second round were fed back to the panel in the third round in order to allow them to rate their opinion in the light of those of the rest of the panel (Jones & Hunter, 1995).

3.6 Ethical issues

Ground rules and ethical guidelines need careful discussion and planning with respect to recruitment of the panellists, anonymity issues, type of initial contact and method and extent of communication and feedback with the selected panellists. If not carried out correctly, the response rates could be affected in ongoing rounds (Hasson *et al.*, 2000).

The Delphi process is usually anonymous and confidential (Williams & Webb, 1994; Hasson *et al.*, 2000). The issue of anonymity, although viewed by Clayton (1997) as strength of the technique has been criticized by Sackman (1975) because it is seen as removing accountability from panellists. Other studies have advocated a quasi-anonymity whereby the panellists are known to the researcher but not to each other. This may improve the accountability issue raised by Sackman (1975) while still maintaining the advantage of the Delphi in that the panellists will not be intimidated by one another. In this research, the quasi-anonymity method was employed. Anonymity amongst panel members was assured, however the panellists were known to the researcher. This was deemed necessary for follow-up purposes (Hasson *et al.*, 2000). Panellists were however assured of strict confidentiality.

The nature of the contact (i.e. cold contact versus personal contact) made with potential panellists can influence the response rates, especially so with the Delphi, as panellists have to commit to the process (Hasson *et al.*, 2000). Reid (1993) describes a basis for a letter to the Delphi panellists which suggests the following information:

1. You have been selected as an expert to serve on the panel.
2. I will correspond with you in writing, using sequential questionnaires interspersed with summarised information.
3. I will attempt to systematically produce consensus of opinion and to identify opinion divergence.
4. Your anonymity and that of the rest the panel members and their statements is assured.

5. There will be iteration and controlled feedback.

6. The study will be conducted using the Delphi Technique which involves your participation (by way of a reaction to the items listed and generated by others on the clinical competencies required by entry-level radiographers) in a series of rounds between which a summary of the results of the previous round is communicated to and evaluated by panel members.

The research proposal was approved by the Higher Degrees Committee and Research Ethics committee of the then Peninsula Technikon on the 6th October 2004. The panellists were informed of the research process and intentions in a letter (see appendix B). Panellists were required to sign a letter of consent (appendix B1) reflecting their agreement to the ethical issues as outlined in appendix B1. A summary of the research design is provided in Table 3.5.

Table 3.5: Summary of the research methodology

Research question	Research method	Research instrument	Data produced	Data analysis
1. What is expected of new graduates in the workplace?	Delphi technique	3 rounds of a structured descriptive questionnaire (de Vaus, 1999) with feedback between rounds	1. Quantitative data derived from a 4-point Likert scale 2. Qualitative data derived from commentary from the panellists	1. Mathematical computation of means and standard deviations for each clinical competency in order to measure consensus and dispersion of opinion for each clinical competency 2. Thematic analysis of commentary either: - emergence of additional clinical competencies - collation of duplication of competencies - clarification of items by way of re-phrasing
2. Is there a gap between the clinical education (expectations) and reality?	Delphi technique	3 rounds of a structured questionnaire with feedback between rounds	1. A comparison will be drawn between the opinions of radiography academics and radiography practitioners from the questionnaires on items where consensus of opinion was reached and areas where divergence existed	1. A test to see if there is a relationship between the responses of academics and practitioners. If the data was not normally distributed around the separate means, the Mann-Whitney test is used. Statistically significant relationships will be seen if $p \leq 0.05$. 2. The model of Remmen in Moercke and Eika will be used as a framework for discussions.
3. What are the implications of the clinical competencies identified for benchmarking undergraduate assessment practices?	Delphi technique	3 rounds of a structured questionnaire with feedback between rounds	1. The clinical competencies agreed on by the expert panel will be transposed into the Model of Practice Domains.	The model of practice domains adapted from Melnick *et al.*, (2002) (Figure 1.3) will be used as a basis for the practice domains of a diagnostic radiographer and clinical assessment practices.

3.7 Summary of and reflection on the Delphi technique

Scheele (1975) summarises the Delphi interaction process as follows:

1. It is a shared actuality that is initially formulated by firstly the panellists from their expectations and secondly from the approach used in the original materials. This actuality is then elaborated and customised by successive interactions. The shared actuality in this research was the clinical competencies (both explicit and implicit) as they appear in the interim SAQA documentation.
2. The interaction process may be affected by personal esteem, the group's self-concept and world-views when responding to the questionnaires.
3. Interaction processes (refer to Table 3.3) can be nurtured, broken down or changed in order to achieve greater outcomes.
4. The principles and guidelines which result from this study is perhaps more important that the detailed (explicit) list of clinical competencies produced by the panellists.
5. The results need to match the reality of the interaction with the quality of the information generated in order to satisfy the issue of validity.

While every effort has been made to ensure the validity and reliability of this research, the interpretation and discussion of the results must take cognisance of these issues. The technique is essentially a communication process and the truth of the results is dependent on the efficiency and fairness of the communication process which relates directly to the researcher's ability to ask questions and summarise the results accurately (Linstone & Turoff, 1975). The Delphi inquiry system has been categorised as

"Lockean" which has data as its main component (Mitroff & Turoff, 1975). Careful consideration was given to the questionnaire design and construction and thus the initial data input sector (refer to Figure 2.8) was a list of clinical competencies, which the researcher developed from the interim SAQA registration and a literature review. Current role extension possibilities found in the literature was also included. The researcher acknowledges that she may have influenced which clinical competencies were included in the construction of the first round questionnaire and thus recognises that the list of clinical competencies (Table 4.17) may not be complete. If an open-ended design was used in the first round questionnaire, the results may well have been different (Scheele, 1975). The design of all three rounds of questionnaire allowed the panellists the opportunity to give free form responses in the hope of increasing the "truthfulness" of the group's interaction.

A critique of the Lockean inquiry system is that data is emphasized to the detriment of theory (Scheele, 1975). The theory component of the Lockean inquiry system (refer to Table 3.1) was strengthened because at the outset of the research it was stated that the data would be applied to the following theoretical models, namely; the clinical skills curriculum model of Moercke and Eika (2000) (Figure 1.2), the Practice Domain model adapted from Melnick *et al.*, (2002) (Figure 1.3), the Miller's model (Figure 2.3) and Cambridge model (Rethans *et al.*, 2002) (Figures 2.3 and 2.4) and the Dreyfus and Dreyfus model in Benner (2001) (Figure 2.5). The ultimate aim of this process was to provide a basis for a model for standards of proficiency for newly qualified radiographers in South Africa. The truthfulness of the communication is also dependent on the panel's expertise and honesty and thus care was taken in the sampling

techniques. Respondent bias was minimised by monitoring response rates throughout the 3 successive rounds to ensure some form of representation from each of the HEIs in all 3 rounds.

The group's response is affected by their self-concept and world views and thus the interpretation of the results needs to reflect this (Scheele, 1975). There is evidence of "transactions" (refer to Table 3.2) as the results of the panel have greater authority than that of individuals. The final round comprised 40 panellists who gave their opinion on the clinical competencies. Comparisons were drawn between the responses of 21 academics and 19 clinical practitioners in order to evaluate alignment between education and the workplace. This sample size according to Brink (2000) decreases the likelihood of individual meanings thereby increasing the reliability of the results.

"Experience" type interactions have also manifested themselves in that the original items (list of clinical competencies) have served as a starting point for comment on role extension possibilities. "Events" are evident in that the differences in opinions between academics and clinical practitioners may be guided by hierarchy in the clinical departments in terms of "the way things are done". Finally there are also traits of "occurrences" because the stability of the results from round 2 to round 3 shows divergent opinion on role extension possibilities which implies that panellists are ambivalent regarding world views on role extension opportunities.

In general though, there were similarities in the consensus competencies of newly qualified radiographers and the UK standards of proficiency. Some new ways of

thinking also emerged with regard to consensus on the Red Dot System and the radiographer giving a *verbal* report on accident and emergency plain film radiography. There was even some criticism by panellists who remarked that if radiographers took on the role of radiologist, what would the radiologist actually do? This "criticism" is typical of an "occurrence" interaction.

CHAPTER 4

RESULTS OF THE CLINICAL COMPETENCY REQUIREMENTS

> In many ways it is easier to assess competence than performance. Unfortunately, competence does not always correlate highly with performance in practice (Newble,1992:505).

4.1 Introduction

In this chapter, the response rates are recorded for each of the three rounds. The results of this research produced both quantitative and qualitative data. The quantitative data (arising from the central tendency and dispersion scores) will be discussed with reference to the following:

- clinical competencies *achieving consensus*;
- clinical competencies *not* achieving consensus;
- categorical analysis between the opinions of academics versus clinical practitioners; and categorical analysis between the opinions of clinical practitioners employed by the state versus those employed in the private sector.

The results of the qualitative data (arising from the "free-form" responses) will be discussed with reference to the following:

- additional clinical competencies emerging; and
- clarification of terminology.

4.2. Findings from round one of the questionnaire

4.2.1 Quantitative findings: round one

The data for each round of the questionnaire was analysed according to Table 4.1 which considered the mean scores for each clinical competency.

Table 4.1 Scores relating to consensus

Mean score for each clinical competency	Interpretation
<2 (<50%)	Consensus that the stated clinical competencies are *not necessary* for a newly qualified diagnostic radiographer
≥2;≤3 (≥50%≤75%)	Divergent opinion regarding the inclusion of the stated clinical competencies as necessary for a newly qualified diagnostic radiographer (i.e. consensus not reached)
>3 (>75%)	Consensus that the stated clinical competencies *are required* by newly qualified diagnostic radiographers

Of the 109 clinical competencies listed in the first round questionnaire, there was consensus that 94 (86,23%) of the clinical competencies listed were necessary for the newly qualified radiographer.

Clinical competencies not required by newly qualified radiographers were also identified as indicated in Table 4.2

Table 4.2 Clinical competencies not required by newly qualified radiographers

Mean score	Clinical competencies
<2 (<50%)	1. Perform magnetic resonance (MRI) examinations 2. Administer intravenous contrast media 3. Perform basic abdominal ultrasound scanning (excluding Doppler) 4. Perform basic obstetric ultrasound scanning (excluding Doppler)

With reference to clinical competencies depicted in Table 4.2, a clinical competency in performing MRI is seen as advanced practice (White & Mc Kay, 2002) and not a pre-requisite for new registrants (Health Professions Council of the United Kingdom, 2003). Clinical competencies in the administration of intravenous contrast media and abdominal and obstetric ultrasound are considered as role extension competencies

(requiring additional education) which would normally be undertaken suitably qualified health care professional (White & McKay, 2002; Nightingale & Hogg, 2003).

Clinical competencies on which consensus could not be reached, were also identified in Table 4.3.

Table 4.3 Competencies on which consensus could not be reached

Mean score	Clinical competencies
≥2;≤3 (≥50%≤75%)	1. Perform mammography investigations 2. Perform computerised tomography investigations 3. Perform interventional radiography investigations 4. Correctly store, manipulate and retrieve digital images 5. Report on pattern recognition in general radiography 6. Report on Accident and Emergency plain film radiography (Red Dot System) 7. Assess trauma patient's injuries 8. Conduct forensic radiography 9. Conduct research 10. Integrate research into practice 11. Teach and advise peers

With reference the Table 4.3 above, a clinical competency in mammography, computerised tomography and complex contrast procedures (i.e. interventional radiography), are not pre-requisites for registration of new graduates (Health Professions Council of the United Kingdom, 2003; Cavallin, 2006). In the UK and US, newly qualified radiographers are expected to assist a more senior radiographer with these examinations.

Categorical analysis: round one

All of the clinical competencies from round 1 (109 items) were also analyzed to see if there were any statistically significant differences between the opinions of the radiography academics and radiography practitioners. A Mann-Whitney U test was

used and statistically significant differences were taken at $p \leq 0.05$. Statistically significant differences were seen with the following:

Clinical competency	Figure
1. A clinical competency in determining the need for additional projections	Figure 4.1
2. A clinical competency in reporting on pattern recognition in general radiography.	Figure 4.2
3. A clinical competency in reporting on Accident and Emergency plain film radiography (Red Dot System).	Figure 4.3
4. A clinical competency in setting up and monitoring a reject analysis program.	Figure 4.4
5. A clinical competency in performing basic Quality Control tasks (x-ray machine and processor QC).	Figure 4.5
6. A clinical competency in effectively presenting information technology	Figure 4.6

The above-mentioned clinical competencies are depicted below (Figure 4.1- 4.6). On examination of the graphs below, the mean scores of the academics are generally higher than those of the clinical practitioners. This indicates that academics are in favour of the new graduates possessing these competencies whereas the clinical practitioners are not.

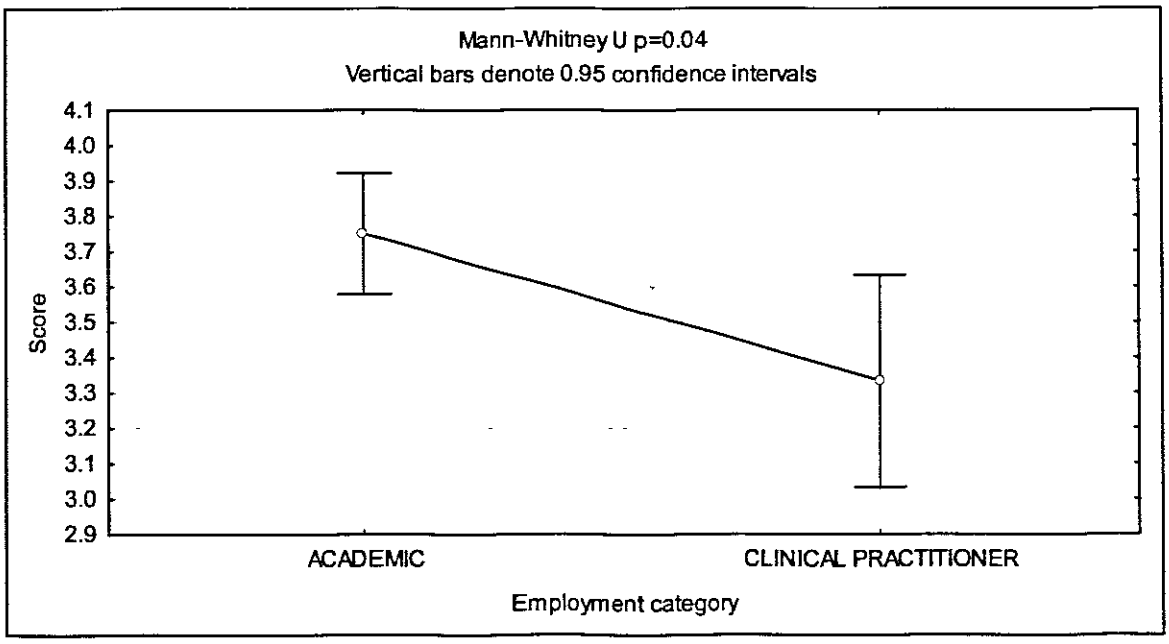

Figure 4.1 Determining the need for additional projections.

With reference to Figure 4.1, both academics and practitioners are in agreement that newly qualified radiographers should be able to determine the need for additional projections. The range of scores for academics was however higher, indicating a stronger agreement.

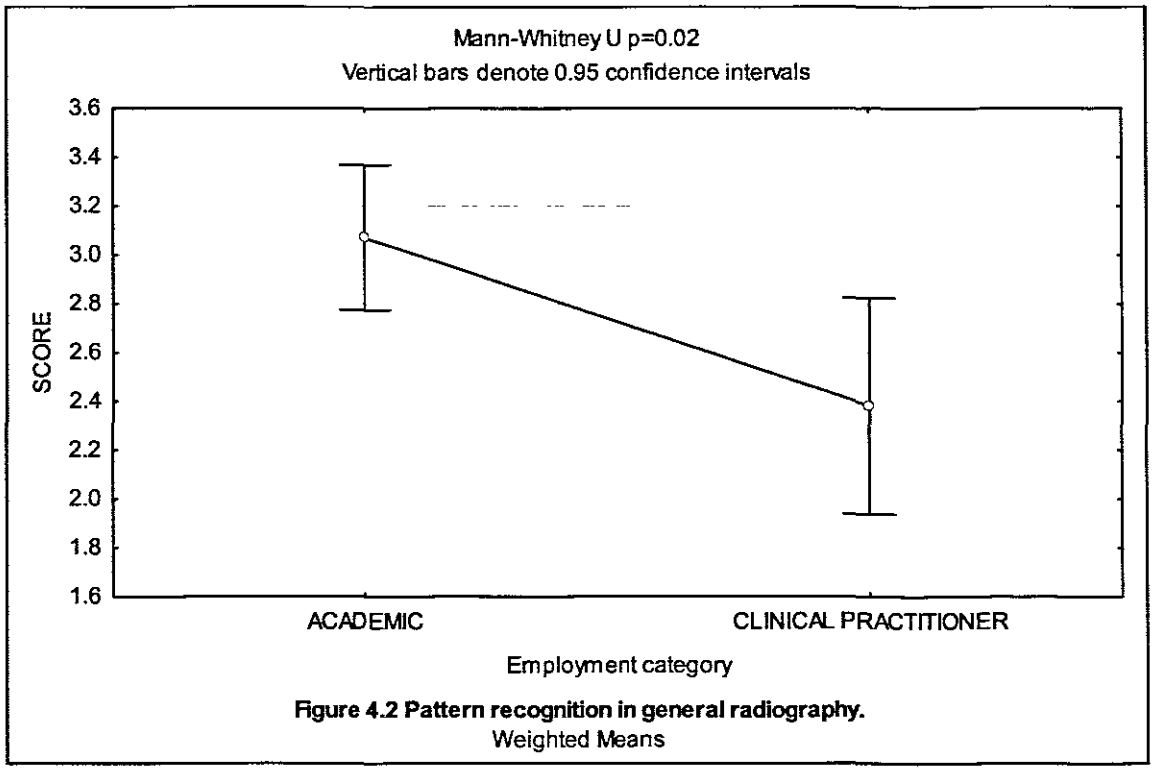

Figure 4.2 Pattern recognition in general radiography.

Note that the mean score for the academics is above 3 (Figure 4.2), while that for the clinical practitioners is below 3, an indication that academics were in agreement with newly qualified radiographers having a clinical competency in reporting on abnormal patterns in general radiography, while clinical practitioners were unsure. The same holds true for reporting using the Red Dot System (Figure 4.3).

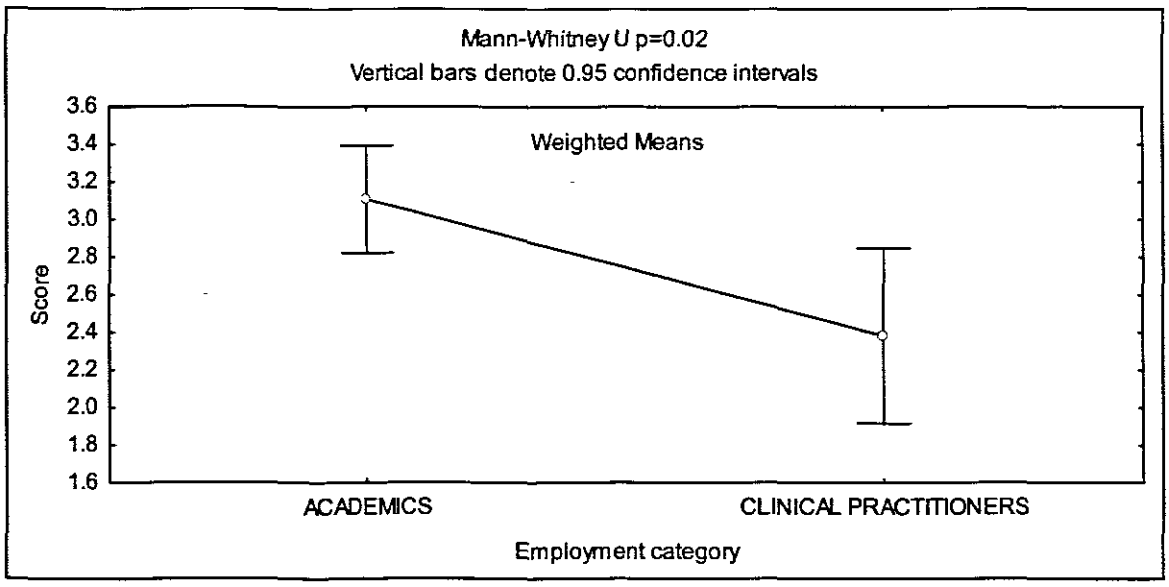

Figure 4.3 Reporting on Accident and Emergency plain films (Red Dot System)

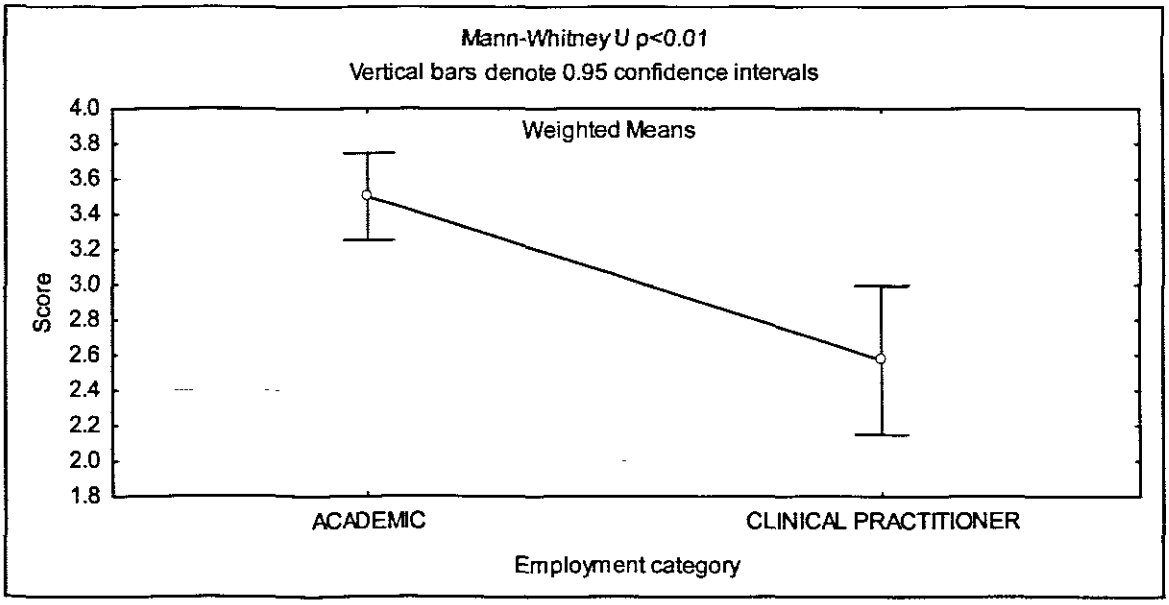

Figure 4.4 Setting up and monitoring a reject analysis program.

The two clinical competencies depicted in Figure 4.4 and 4.5 relate to managerial tasks. Academics were clearly in favour of new graduates being competent to set up and monitor a reject analysis programme (Figure 4.4), (mean =3.5), while clinical practitioners were unsure (mean = 2.6). Although both were in agreement for a clinical

competence in performing quality control procedures, academics responses were more in favour of this competency (Fig 4.5).

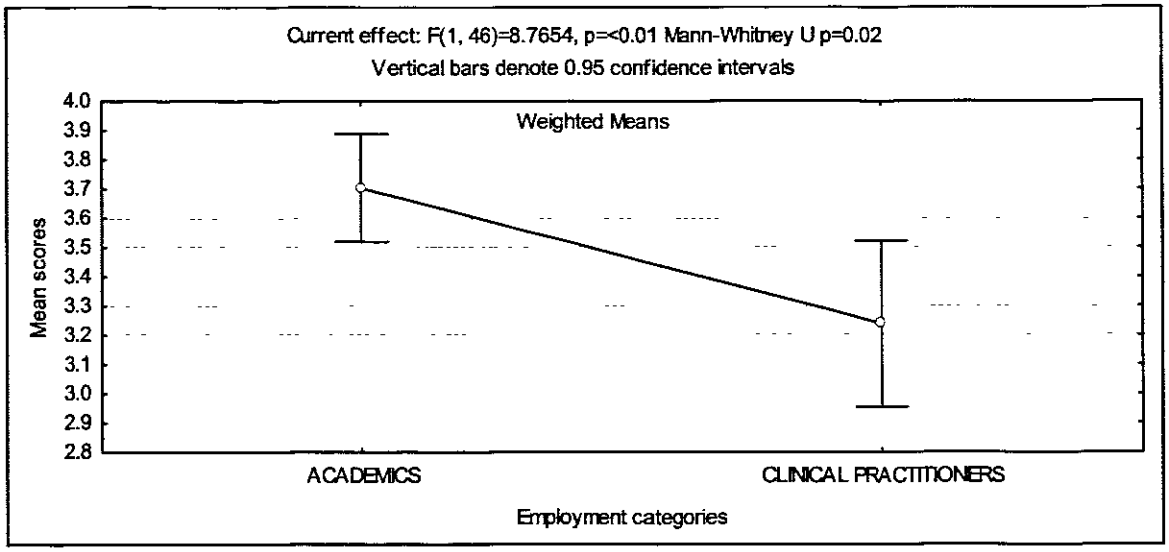

Figure 4.5 Perform basic QC tasks.

Effective presentation of information literacy (Figure 4.6) is one of the Critical Cross field Outcomes associated with Outcomes based education (Van der Horst & McDonald, 1997). From Figure 4.6 below, it is evident that academics are in favour of this competency (mean >3.4) while clinical practitioners are unsure (mean <3).

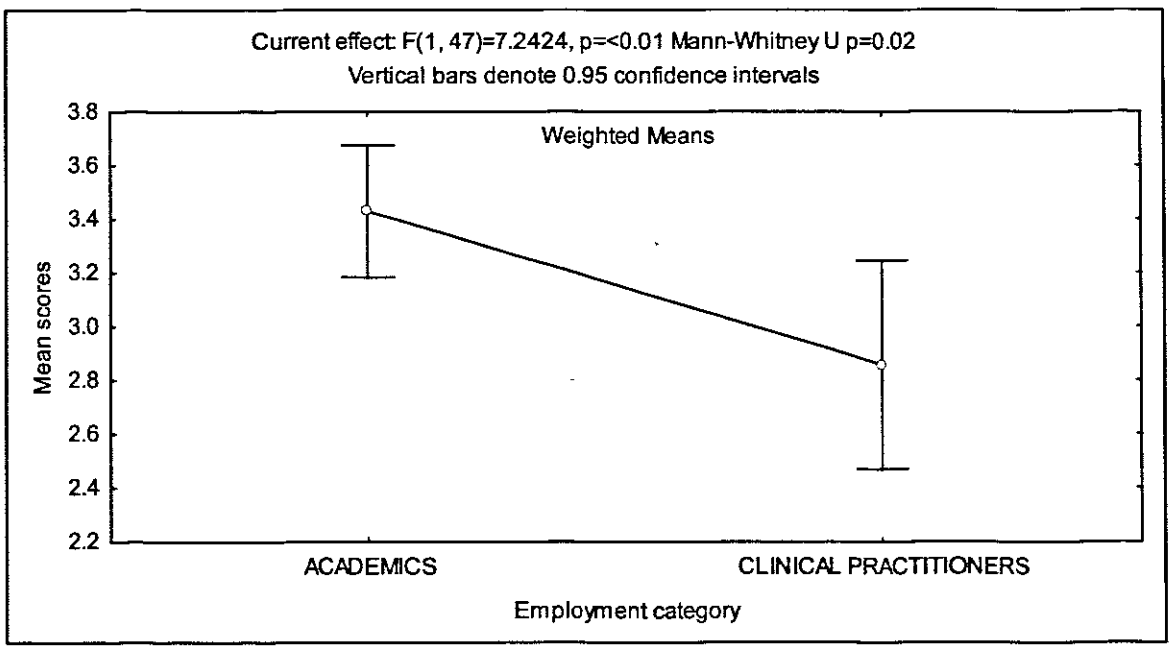

Figure 4.6 Effectively present information technology

There were also some additional clinical competencies which scored significant differences of consensus between academics and clinical practitioners (refer to Table 4.4).

Table 4.4 Additional clinical competencies with statistically significant values ($p \geq 0.05$-0.09).

Mann-Whitney U *p* value	Clinical competency
0.09	Adapt positioning to demonstrate specific pathology
0.06	Take remedial action if the radiographs are not of diagnostic quality
0.07	
0.05	Liaise with nursing staff
0.05	Discuss techniques with referring clinicians
0.05	Enter and record patient's details and examinations requested
0.06	Organize the daily work schedule
	Debate issues related to health care

An analysis was also done to see if there were any statistically significant ($p<0.05$) differences in the opinions of radiography practitioners employed by state institutions and those employed by the private sector. No significant differences were noted. The sample size of practitioners from the private sector is small ($n= 6$), therefore it would be unwise to consider the results as generalisable.

Summary

All of the clinical competencies depicted in Table 4.4 and Figure 4.1-4.6 relate to higher order cognition and have elements of managerial skills. The fact that the mean scores of the clinical practitioners are lower may be as a result of hierarchy within the clinical departments. The statistical differences of opinions of academics and clinical practitioners as indicated in Table 4.4 and Figure 4.1-4.6 highlight the fact that there are

differences in the expectations of those involved with the "intended curriculum" and those involved with the "learned curriculum" (Moercke & Eika, 2002).[12]

4.2.2 Qualitative findings: round one

In this section, I present the findings from the analysis of the free-form comments on the questionnaire using recurring themes namely: clarification of terminology, additional competencies emerging and possibilities for inclusion in the scope of practice.

There were 13 statements of clinical competencies (Table 4.5) in round one that respondents needed clarifications in terms of the terminology used to describe the competencies. These are listed in Table 4.5.

Table 4.5 Clinical competencies needing clarification.

Clinical competency
1. Application of knowledge of Bio-medical sciences
2. Perform a barium swallow 3. Perform a barium meal 4. Perform a small bowel enema 5. Perform a barium enema
6. Report on pattern recognition in general radiography
7. Monitor the patient's medical equipment
8. Prepare contrast media
9. Coping with death
10. Resolving conflict
11. Routine paediatric radiography
12. Perform interventional radiography
13. Assess the trauma patient's injuries

The comments were grouped into recurring themes as illustrated in Table 4.6.

Table 4.6 Themes of analysis.

Theme	Clinical competency needing analysis
1.Unfamiliar terms (some panellists needed clarification of certain terms).	- Biomedical sciences
2. Extent or level of practice (this refers to the extent of involvement of the radiographer).	- Monitor medical equipment - Resolve conflict - Assessing injuries - Coping with death
3. Stricter definitions (these words needed	- Perform

[12] Refer to appendix I, page 184 for a definition of the intended and learned curricula.

to be defined more clearly in the context of the clinical workplace).	- Interventional radiography - Routine - Reporting - Contrast media

Rewording or clarification of these competencies thus formed the first section of the 2nd round questionnaire (see appendix G, section B1).

There were also an additional 22 statements of clinical competencies which were suggested by the panel in round 1 and further developed (see appendix G, section B2). These additional competencies were incorporated into the 2nd round questionnaire for rating by the panel.

The four competencies which were rated as not being a necessity for newly qualified radiographers [13] were further investigated in terms of whether they should be part of the scope of practice of the radiographer at all (see appendix G, section B3). This investigation was necessary to complete the formulation of a practice domain model (Melnick *et al.*, 2002) [14] for the radiographer. This model has three components, namely the "observable practice", the "potential practice" and the "professional field". The "potential practice", for purposes of this research refers to the extended practice of the radiographer. The clinical competencies not deemed to be a requisite for newly qualified radiographers (Table 4.2) were further investigated to see if they should be part of this "potential practice".

Finally, the other seven clinical competencies on which consensus could not be reached, were further explored in terms of whether the new graduate should; posses a theoretical

[13] Refer to Table 4.2, page 102.
[14] See page 13.

knowledge, receive practical education or whether that competency should be an elective (appendix G, section B4).

4.3 Findings from round two of the questionnaire

The first part of this section deals with results of qualitative and quantitative data with respect to the extended clarifications of terms and the additional clinical competencies from round one that were sent back to all the panellists in round two for rating. Further clarifications were also needed. The categorical analysis is presented and finally a qualitative analysis is done with respect to the aim of the questionnaire.

4.3.1 Quantitative findings

Refer to section B1 (appendix G). There was consensus that "perform" for a newly qualified radiographer with respect to barium studies and excretory urograms clearly meant "to assist the radiologist" and that performing the barium swallow, meal, small bowel enema and large bowel enema and excretory urogram without the assistance of the radiologist were not clinical competencies required by newly qualified diagnostic radiographers as indicated by Table 4.7.

Table 4.7 Contrast media studies

Mean score	Standard deviation	Clinical competencies
1.800	0.964	1. Perform a barium swallow without the assistance of a radiologist
1.686	0.993	2. Perform a barium meal without the assistance of a radiologist
1.588	0.892	3. Perform a small bowel enema without the assistance of a radiologist
1.500	0.880	4. Perform a barium enema without the assistance of a radiologist
1.929	0.997	5. Perform excretory urography independently without the assistance of a radiologist

The differentiation was made between giving a verbal report to the referring clinician and giving a written report to the referring clinician in general radiography. The results are indicated in Table 4.8. Consensus could not be reached on whether these clinical competencies are required of newly qualified radiographers. Note that the standard deviation for providing a written report is greater than that for a verbal report. This indicates that there was greater divergence of opinion for the written report.

Table 4.8 The difference of opinion between verbal and written reports.

Mean score	Standard deviation	Clinical competencies
2.950	0.959	1. Provide a verbal report to the referring clinician
2.175	1.152	2. Provide a written report to the referring clinician.

With reference to section B2 in questionnaire two (appendix G), which deals with the additional clinical competencies that emerged from round one, consensus could not be reached with three of the clinical competencies indicated in Figure 4.9.

Table 4.9 Additional competencies from round one not achieving consensus.

Mean score	**Standard deviation**	**Clinical competency**
2.432	0.846	1. The ability to devise a business plan for a radiography practice
2.205	0.765	2. The ability to recognise when to send a patient for emotional counselling
2.511	0.843	3. The ability to communicate with the referring clinician on matters relating to the emotional well being of the patient

With reference to section B3 (in appendix G) which explored the clinical competencies from round 1 where it was agreed that those competencies were not expected of new graduates, these competencies were again presented to the panel to explore whether these competencies should be included in the scope of practice of the radiographer, with additional education (Table 4.10). Consensus was reached on only one clinical

competency; that of performing Magnetic Resonance Imaging could be in the radiographer's scope with additional training.

Table 4.10 Competencies that should be included in the scope of practice with additional education.

Mean score	Standard deviation	Clinical competency
3.341	0.776	1. Perform Magnetic Resonance Imaging
2.867	1.036	2. Administer intravenous contrast media
2.933	0.963	3. Perform basic abdominal ultrasound (excluding Doppler)
2.933	1.009	4. Perform basic obstetric ultrasound (excluding Doppler)

Section B4 in appendix G deals with those clinical competencies from round one where consensus could not be reached. The clinical competencies were re-worded as follows:

Table 4.11 Rewording of statements for clinical competencies on which consensus could not be achieved in round one.

Clinical competency	**Theoretical knowledge only (means)**	**Practical education (means)**	**Should be an elective (means)**
1. Perform mammography investigations	2.045	3.256	2.444
2. Perform computerised tomography investigations	1.738	3.250	2.231
3. Correctly store, manipulate and retrieve digital images	2.140	3.400	2.000
4. Conduct forensic radiography	2.341	2.628	2.537
5. Conduct research	3.071	2.933	2.105

From these results, it is apparent that the consensus of the panel is that clinical exposure to mammography, computerised axial tomography and digital imaging are necessary in the undergraduate clinical curriculum, whereas forensic radiography is not. It was still however not clear whether a clinical competency was required in mammography, computerized axial tomography and digital imaging. A theoretical knowledge of the research process was also seen to be a necessary requirement. These competencies were therefore re-phrased for clarity in the 3rd round.

Categorical analysis

All of the clinical competencies from round 2 were also analysed to see if there were any statistically significant differences between the opinions of the radiography academics and radiography practitioners. A Mann-Whitney U test was used and statistically significant differences were taken at $p<0.05$. Statistically significant differences were seen with the following clinical competencies:

Clinical competency	**Figure**
1. A clinical competency in providing a written report in general radiography.	Figure 4.7
2. A clinical competency in dealing with relatives of a patient who has died.	Figure 4.8
3. A clinical competency in acknowledging when to seek emotional support for oneself.	Figure 4.9
4. A clinical competency in understanding the role of the regulatory bodies with respect to the safe use of radiation.	Figure 4.10
5. The ability to competently devise a business plan for a radiography practice.	Figure 4.11
6. A clinical competency in communicating with the referring clinician on matters relating to the emotional well being of the patient.	Figure 4.12
7. A clinical competency in understanding the patients needs with respect to HIV and AIDS.	Figure 4.13
8. A clinical competency in computer literacy in order to access and utilize the hospital records system.	Figure 4.14
9. A clinical competency in administering IV contrast media.	Figure 4.15

With reference to Figure 4.7, it is noted that academics are unsure (mean ≤ 3) whether the newly qualified radiographer should be able to write a report for general radiography. Clinical practitioners were however decisive that newly qualified radiographers should not write reports (mean <2). This clinical competency fits into the extended role category as traditionally radiologists write the reports. The opinions reflected in this result are no doubt influenced by professional accountability and the

legal requirements of role extension (Pettigrew, 2000; White & McKay, 2006; Hardy & Persaud, 2001).

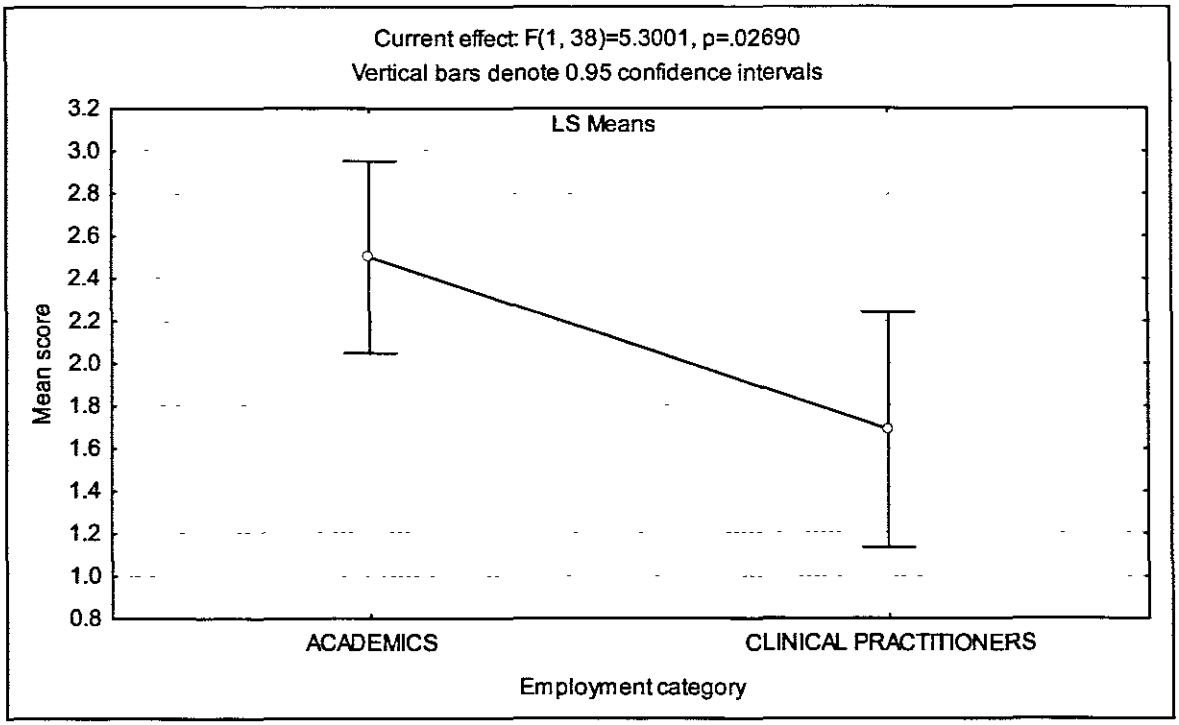

Figure 4.7. Provide a written report in general radiography

The clinical competencies reflected in Figure 4.8 and 4.9 relate to both personal management and the management of others with respect to coping strategies. The results indicate that academics are more in favour of newly qualified radiographers possessing these coping strategies.

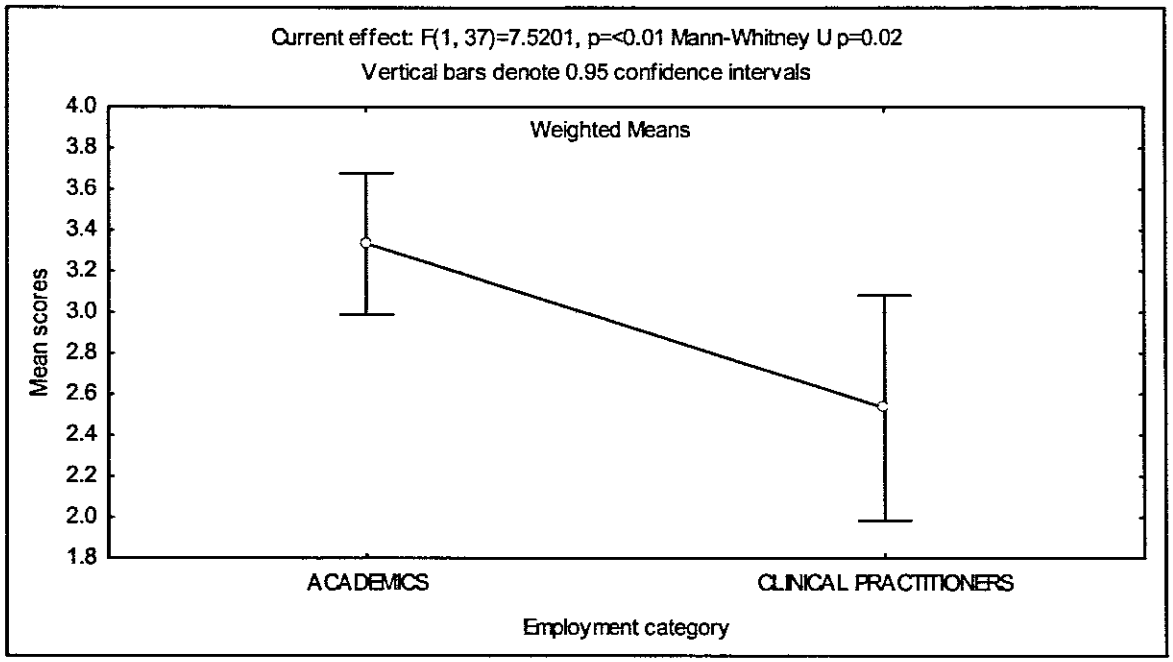

Figure 4.8 Coping with relatives of a dead patient.

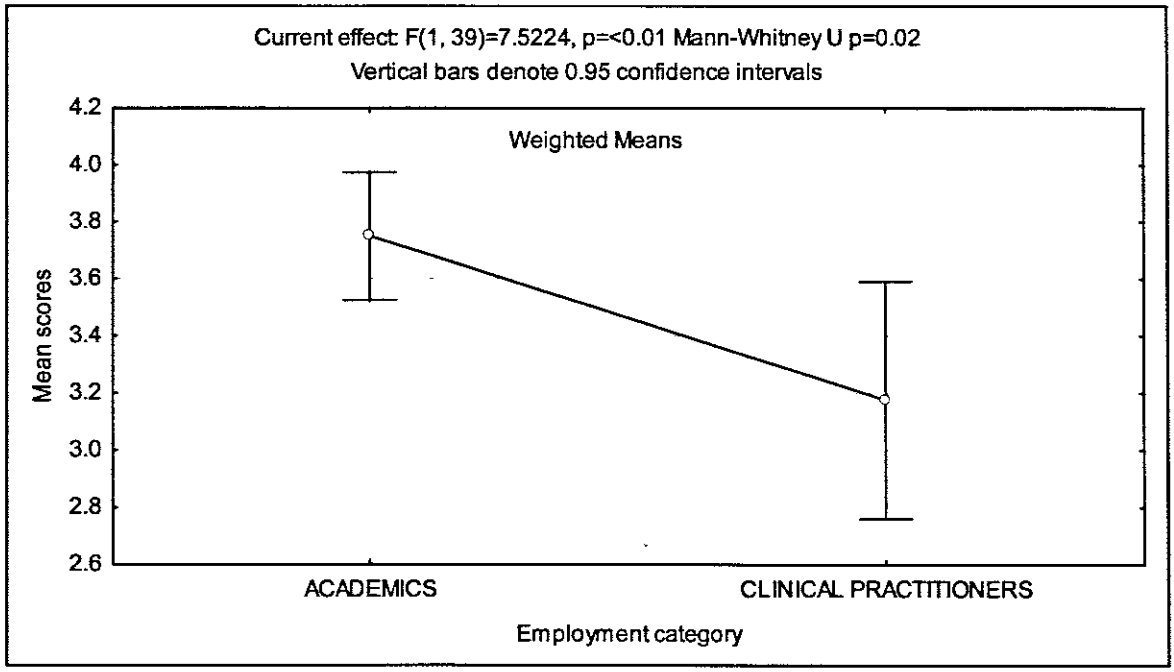

Figure 4.9 Acknowledging when to seek emotional support for oneself.

With reference to Figure 4.10, both academics and clinical practitioners were in agreement that newly qualified radiographers should understand the role of regulatory bodies.

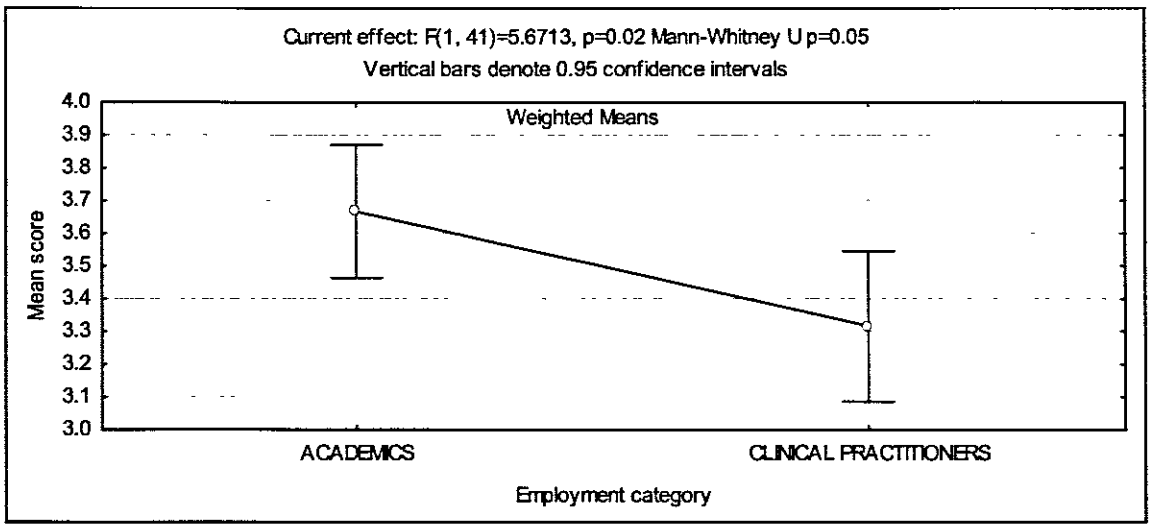

Figure 4.10 Understanding the role of the regulatory bodies.

Figure 4.11 illustrates that both academics and clinical practitioners were ambivalent about newly qualified radiographers being able to devise a business plan for a radiography practice. This result may relate to legal aspects and the fact that medical dominance by Radiologists still exists as professionals try to protect their practice domains (White & McKay, 2002).

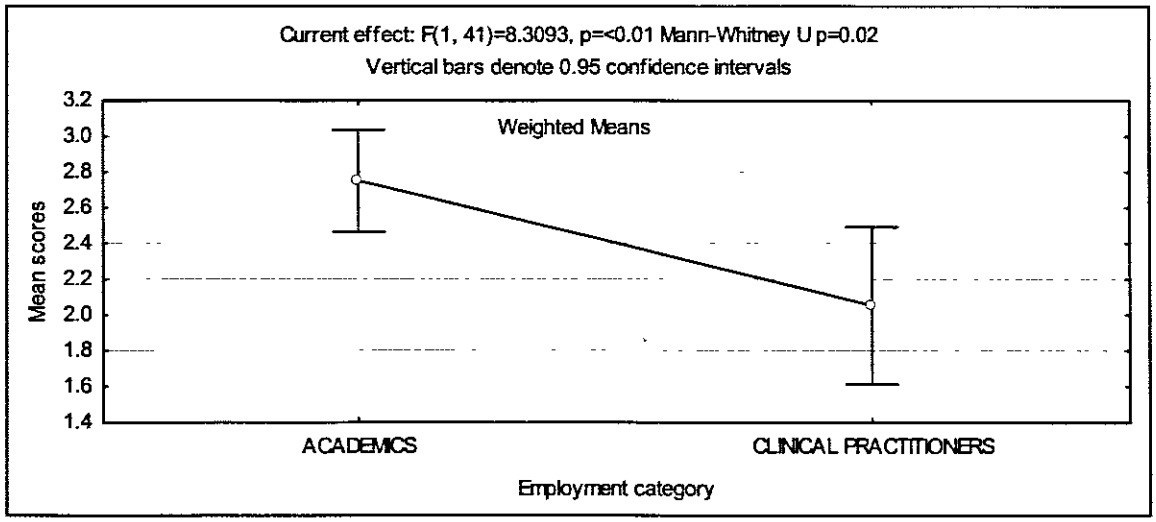

Figure 4.11 The ability to devise a business plan for a radiography practice.

Figure 4.12 reflects a clinical competency that relates to the management of the physical and emotional well-being of the patient. Again both academics and clinical practitioners

were ambivalent regarding the radiographer possessing a clinical competence in discussing the emotional needs of the patient.

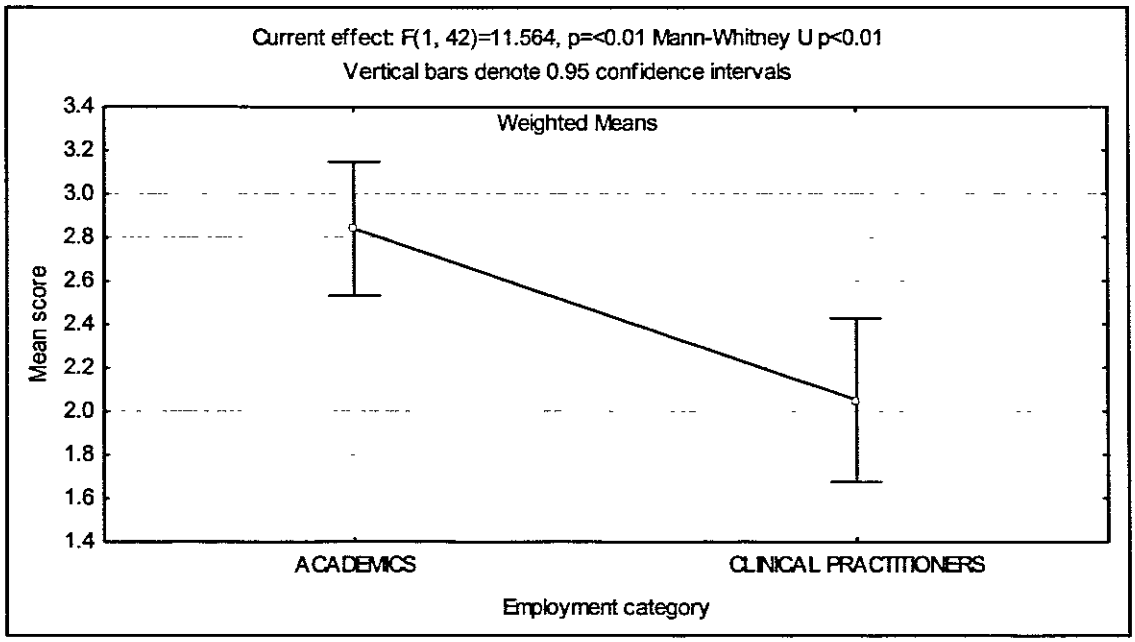

Figure 4.12 The ability to communicate with the referring clinician on matters relating to the emotional well being of the patient.

However, with reference to Figure 4.13, academics revealed that a clinical competency in understanding the needs of the HIV and AIDS patient is strongly suggested; however clinical practitioners were ambivalent regarding this competency.

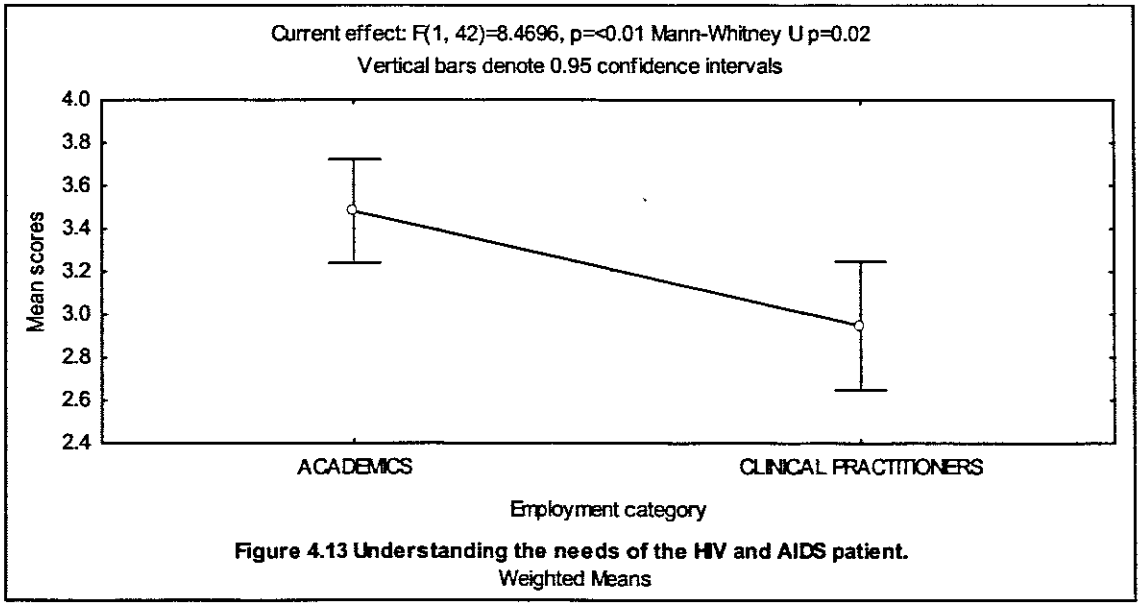

Figure 4.13 Understanding the needs of the HIV and AIDS patient.

Computer literacy is considered a Critical Cross-field Outcome (Van Der Horst & McDonald, 1997). As illustrated in Figure 4.14, academics place a greater significance in this competency than do the clinical practitioners.

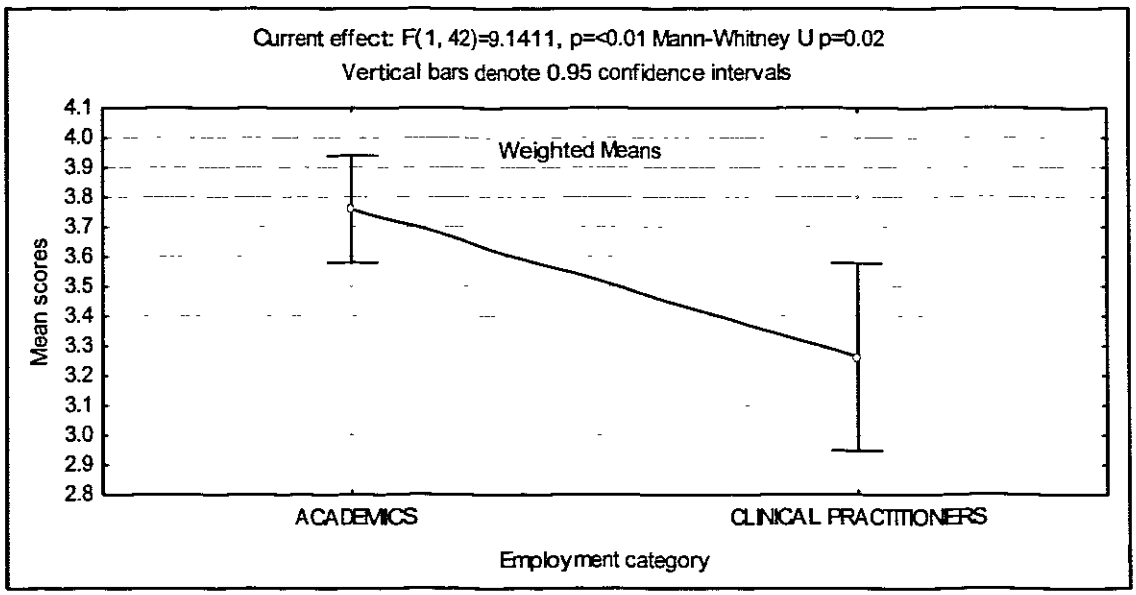

Figure 4.14 Computer literacy

The administration of intravenous contrast media was given consideration for inclusion into the scope of extended practice with additional education. The results (refer to Figure 4.15) indicate that academics were in favour of this (mean >3), while clinical practitioners were ambivalent regarding this issue (mean = 2.5). These results once again reflect the anxiety regarding legal aspects of role extension and the fact that medical dominance by Radiologists still exists as professionals try to protect their practice domains (White & McKay, 2002).

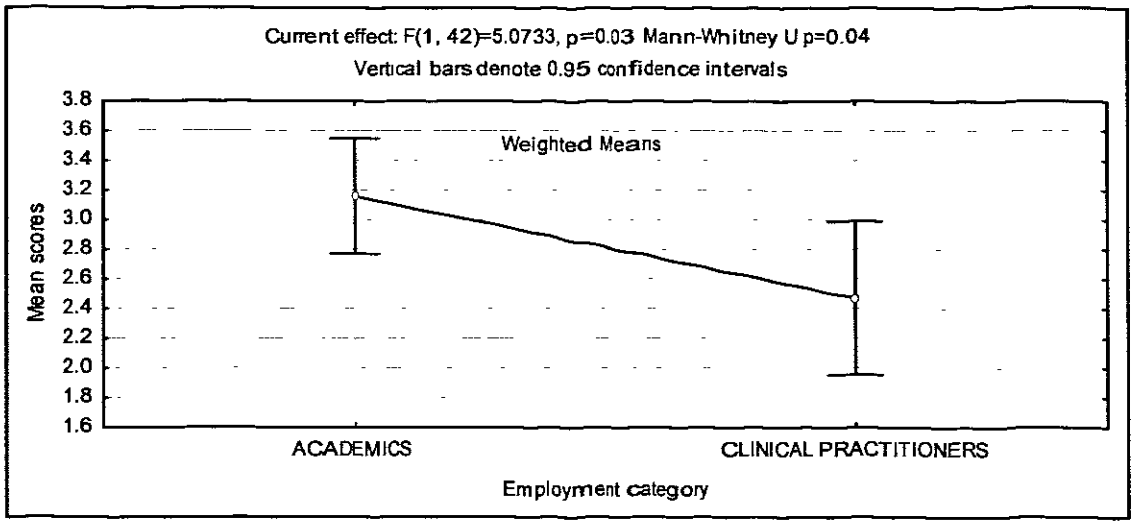

Figure 4.15 Administration of IV contrast media.

4.3.2 Qualitative findings

The qualitative findings in sections B1 (see appendix G) were analysed in similar categories used in round one. The extended clarifications of the recurring themes are provided in Table 4.12.

Table 4.12 Extended clarifications

Theme	Clinical competency
1.Unfamiliar terms (some panellists needed clarification of certain terms).	- *Biomedical sciences*: refers to Anatomy, Physiology, Radiation Science and Pathology.
2. Stricter definitions (this refers to the extent of involvement of the radiographer).	- *Perform:* means either to *assist* the radiologist or *without* the *assistance* of the radiologist. - *Reporting:* means either to provide a *verbal* report to the referring clinician or provide a *written* report to the referring clinician. - *Interventional radiography:* refers to assisting the radiologist with all vascular work - *Routine:* refers to all plain film radiography views - *Prepare contrast media:* refers to mixing barium sulphate preparations and drawing up of iodine based contrast media for IV injections.
2. Extent or level of practice (these words needed to be defined more clearly in the context of the clinical workplace).	- *Monitor medical equipment:* refers to either drip infusions and catheters or vital sign monitors. - *Resolve conflict:* refers to using diplomacy to initiate discussion in a professional context. - *Assessing injuries:* refers to taking a brief clinical history and correlating this with the x-ray request form.

	- *Coping with death;* refers to following correct procedures if a patient dies in your care, dealing with relatives of the deceased and acknowledging when to seek emotional support for oneself.

From the free form responses in the 2nd round questionnaire, respondents voiced their concern over whether the clinical competencies listed were for the present 360-credit diploma, or the proposed 480-credit professional degree and 240-credit early exit. This necessitated development of a statement of aims of this research which is found on the first page of the 3rd round questionnaire (Appendix I).

Summary of the results of round two

As is the case with the results from round 1, most of the clinical competencies depicted in Tables 4.8-4.11 relate to higher order cognition and have elements of patient management. The fact that the mean scores of the clinical practitioners are lower may be as a result of hierarchy within the clinical departments. The competencies relating to role extension have resulted in ambivalent opinions generally which support the literature that South African radiographers are lagging behind their UK counterparts. It may be that in the South African context, the need for role extension is not as evident as in the UK (White & McKay, 2002).

The statistical differences of opinions between academics and clinical practitioners as indicated in Figures 4.7-4.15 highlight the fact that there are differences in the expectations of those involved with the "intended curriculum" and those involved with the "learned curriculum" (Moercke & Eika, 2002).[15]

[15] Refer to page 13.

4.4 Findings of round three of the questionnaire

The first part of this section deals with the quantitative results arising from; the competencies needing clarification from round two, competencies that needed re-ranking, competencies that were considered for inclusion in the scope and clarification of competencies. This is followed by a categorical analysis of the academics and clinical practitioners.

4.4.1 Quantitative analysis: round three

The 3rd round questionnaire was analyzed in the same way as previous rounds (refer to Table 4.1).[16] Sections B1 of the 3rd round questionnaire (appendix I) are those clinical competencies from the second round which needed clarification and were thus re-phrased. The results are tabled below in Table 4.13.

Table 4.13 Clinical competencies from round 2 needing clarification.

Mean score	Standard deviation	Clinical competency
2.57	0.96	1. Perform mammography
2.59	0.89	2. Operate a computerised tomography unit
3.00	0.64	3. Correctly store, manipulate and retrieve digital images
2.92	0.94	4. Conduct a forensic radiography examination
3.74	0.44	5. Mix barium sulphate preparations
3.44	0.75	6. Draw up iodine-based contrast media for IV injections

The results above indicate that only the last two competencies in Table 4.13 above achieved consensus by the panel to be necessary competencies of the newly qualified radiographer. Consensus was not reached again for the first four competencies listed above even with clarification of the statements.

[16] Table 4.1 is on page 102.

In section B2 (appendix I), competencies from round 2 which did not achieve consensus, were carried over with their respective results in percentage. This gave panellists the opportunity to re-rank their responses in the light of the ratings of rest of the panellists (Goodman, 1987; Jones & Hunter, 1995). Refer to Table 4.14.

Table 4.14 The results of round 3 showing the panelists re-ranking.

Mean score (round 2)	Mean score (round 3)	Standard deviation (round 3)	Clinical competency
2.93	2.73	0.816	1. Be able to conduct a research project
2.80	2.40	0.777	2. Be able to critically evaluate relevant research in the field of radiography
2.85	2.65	0.735	3. Be able to implement findings from other researchers into their practice
2.43	2.36	0.584	4. Be able to devise a business plan for a radiography practice
2.95	2.95	0.794	5. Give a verbal report to the referring clinician on any abnormal appearances of general radiographic images
2.18	1.85	0.863	6. Give a written report to the referring clinician on any abnormal appearances of general radiographic images.
2.51	2.85	0.579	7. Be able to communicate with the referring clinician on matters relating to the emotional well-being of the patient
2.93	2.83	0.549	8. Be able to conduct tutorials for CPD
2.21	2.20	0.686	9. Be able to recognize when to send a patient for emotional counselling
3.04	2.98	0.619	10. Perform basic/routine dental radiography examinations
2.80 (round 1)	3.100	0.590	11. Apply the Red Dot System to accident and emergency plain film

The results in Figure 4.14 indicate that there was very little shift in opinions from round two to round three, however where there was a divergence of opinion regarding the radiographer writing a report in general radiography in round 2, consensus is reached in round 3 that it is not a necessary competency expected of the newly qualified radiographer (mean score <2). Consensus was also reached on the competency "Applying the Red Dot System to plain film radiography in Accident and Emergency

radiography". There was consensus in the 2nd round that "Performing basic/routine dental radiography" was a clinical competency required by newly qualified radiographers, however from round 2 there was a need to clarify what was included in routine dental radiography. Round three clarified this by stating that routine dental radiography referred to peri-apical and intra-oral views. This clarification however caused a divergence of opinion. It became evident that some panellists in round 2 presumed "routine dental radiography" to be a panorex or zonarc.

Section B3 of appendix I, dealt with obtaining consensus on the clinical competencies that were rejected as being required by newly qualified radiographers, but which could be included in the scope of practice of the radiographer with additional education (refer to Table 4.15).

Table 4.15 Results of the clinical competencies which may be included in the scope of practice of the radiographer with additional education, but not expected of a newly qualified radiographer.

Mean score Round 1	Mean score Round 2	Mean score Round 3	Standard deviations Round 3	Clinical competencies
1.979	3.341			1. Perform magnetic resonance examinations
1.583	2.867	2.154	0.96	2. Administer intravenous contrast media
1.791	2.933	2.231	0.902	3. Perform basic abdominal ultrasound scanning (excluding Doppler)
1.833	2.933	2.333	0.927	4. Perform basic obstetric ultrasound scanning (excluding Doppler)
		2.179	1.048	5. Insert a needle into a vein in preparation for an IV injection
		2.550	0.959	6. Insert a rectal tube in preparation for a barium enema
		3.050	0.638	7. Comment verbally on Accident and Emergency plain film radiography
		2.075	0.858	8. Comment in writing on Accident and Emergency plain film radiography

The results indicate that there is consensus of opinion that the radiographer should be allowed to provide a verbal comment on Accident and Emergency plain film radiography after some form of additional education.

Section B4 of appendix I sought opinion on the clinical competencies which should be included in the scope of practice of the radiographer in the future. The term "independently" and "without the assistance of a radiologist" (refer round 2, appendix G, section B1) however needed to be clarified in terms of whether the radiologist was absent or supervising, but not present. The results are tabled below in Figure 4.16.

Figure 4.16 Results of clinical competencies that should be included in the scope of practice.

Mean score	Standard deviation	Clinical competency
2.475	0.846	1. Perform all GIT contrast media studies independently in the absence of a radiologist or medical officer
2.125	0.852	2. Write a report on the above examination (in the absence of a radiologist or medical officer)
2.275	0.846	3. Perform an excretory urogram independently in the absence of a radiologist or medical officer
2.125	0.882	4. Write a report on the above examination (in the absence of a radiologist or medical officer)

The results indicate that consensus could not be reached as to whether the radiographer's role should be extended to performing and reporting on contrast media studies independently in the absence of a radiologist.

Categorical analysis

All of the clinical competencies from round 3 were also analysed to see if there were any statistically significant differences between the opinions of the radiography academics and clinical practitioners.

A Mann-Whitney U test was used and statistically significant differences were taken at $p<0.05$. Statistically significant differences were seen with the following clinical competencies:

Clinical competency	Figure
1. A clinical competency in providing a written report to the referring clinician on any abnormal appearances in of general radiography.	4.16
2. A clinical competency in writing a report on an independently performed EUG.	4.17

Both clinical competencies depicted in Figures 4.16 and 4.17, indicate ambivalence and definite exclusion amongst academics and practitioners respectively. They are both clinical competencies which are classified as role extension involving the adoption of the radiologist's role and hence the reluctance of the panellists is evident (White & McKay, 2002).

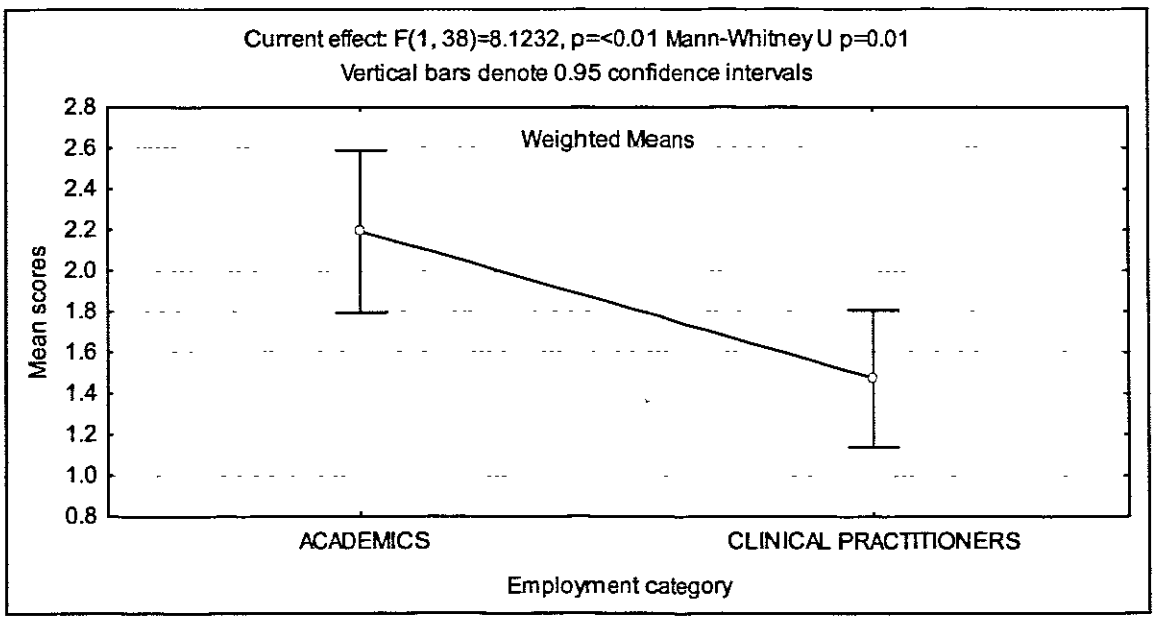

Figure 4.16 Provide a written report

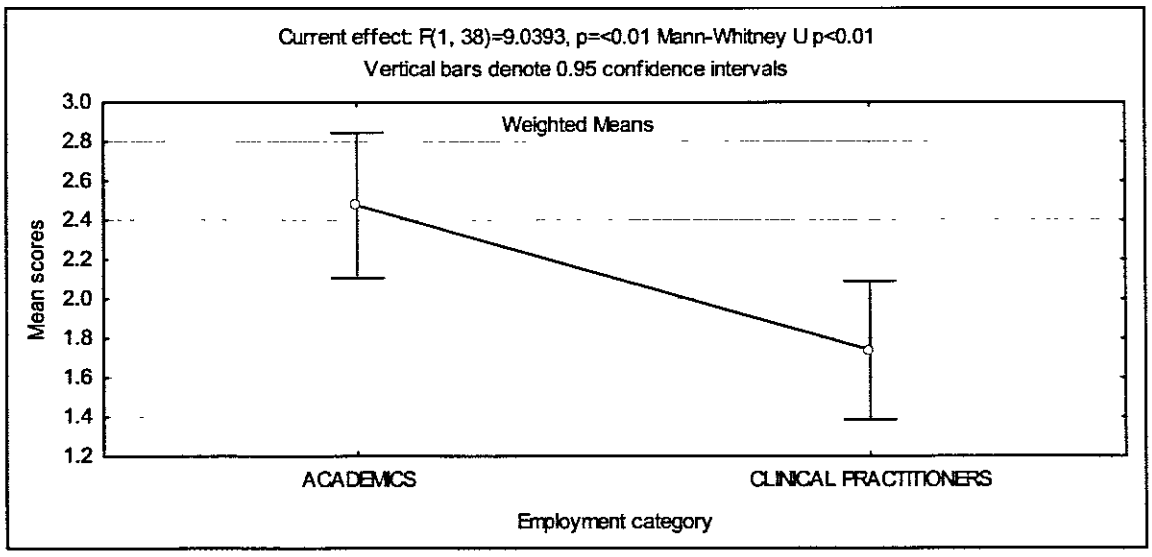

Figure 4.17 Write a report on an independently performed EUG

All of the clinical competencies from round 3 were also analysed to see if there were any statistically significant differences between the opinions of the radiography practitioners in private practice and in the state sector. A Mann-Whitney U test was used and statistically significant differences were taken at $p<0.05$. There were no statistically significant differences.

4.5 The consensus of opinion on the clinical competencies

4.5.1 Clinical competencies required of newly qualified radiographers

In this final section of the results of this research, I present the final opinions of the panellists on the clinical competency requirements of newly qualified diagnostic radiographers in South Africa. Areas of clinical practice which newly qualified radiographers are only required to assist in, are also identified. In addition to this, the clinical competencies which could be included in the scope of practice of the radiographer, with additional education, are also presented. Clinical competencies which should be excluded from the scope of practice are also highlighted. Finally, the

clinical competencies on which academics and clinical practitioners differed, is also highlighted.

Table 4.17 represents all the clinical competencies that obtained the highest and lowest averages over the 3 successive rounds of the Delphi study.

Table 4.17. Average scores of all the clinical competencies for newly qualified radiographers

Clinical competency	Mean
Position the patient correctly for routine radiographic positions	4
Assure appropriate patient care	4
Minimise radiation exposure to patients and public	3.96
Minimise occupational exposure	3.96
Maintain and support patient confidentiality	3.96
Knowing how to protect oneself professionally from HIV/AIDS.	3.91
Communicate effectively with patients	3.9
Work ethically	3.88
Operate equipment safely and efficiently	3.84
Correctly select technical factors	3.82
Implement measures to prevent and control infection	3.82
Work effectively in a team with all categories of professional and support staff	3.82
Display appropriate interpersonal skills	3.81
Willingness to work flexible hours	3.81
Appreciate the need to be accountable	3.81
Recognise an appropriate standard of image quality (critically evaluate radiographs	3.8
Take responsibility for own actions	3.8
Adapt radiography techniques to the trauma patient's injuries.	3.8
Take remedial action if radiographs are not of diagnostic quality	3.79
Adapt technical factors to suit variations in the patient's condition	3.78
Perform independently in general radiography	3.78
Recognise own area of responsibility	3.78
Process radiographic images	3.77
Recognise the lines of responsibility within the department	3.77
Communicate effectively with the patient's relatives	3.76
Identify situations which require advice from senior staff	3.76
Mix barium sulphate preparations	3.74
Identify and respond to changes in the patient's condition	3.73
Observe the patient for signs of adverse reactions to contrast media.	3.73
Able to work in high stress environments e.g. trauma resuscitation room	3.71
Work within the scope of practice of the radiographer	3.7
Be committed to life-long learning	3.7
Able to self evaluate and reflect on behaviour	3.7

Perform theatre radiography	3.69
Perform accident and emergency radiography independently.	3.69
Perform with low repeats	3.67
Liaise with nursing staff	3.67
Follow procedures for reporting any lapses in health and safety regulations	3.67
Be able to adapt to varied work environments	3.67
Able to cope with "on call" duties	3.67
Use own initiative	3.67
Adapt positioning to suit variations in the patient's condition	3.65
Recognise the scope of practice of the radiographer	3.65
Be familiar with the instruments and drugs on the emergency trolley.	3.64
Perform excretory urography with the assistance of a radiologist.	3.63
Adapt positioning to demonstrate specific pathology	3.61
Complete and check clinical request forms	3.61
Coping with the trauma patient	3.61
Liaise with all categories of staff	3.6
Identify problems in the radiographic context	3.6
Listening skills	3.6
Determine the need for additional projections	3.57
Perform basic first aid.	3.57
Demonstrate computer literacy in order to access and utilise the hospital record system.	3.56
Resolving conflict by using diplomacy to initiate discussion in a professional context	3.55
Work with an appreciation for cost	3.53
Offer peer support and encouragement	3.53
Monitor patient's IV infusions, urinary catheters, Oxygen supply in order to recognise when to seek medical assistance	3.52
Communicate effectively verbally and in writing with others in the health care team	3.52
Coping with death by following the correct procedures if a patient dies in the x-ray room	3.52
Acknowledge when to seek emotional support for oneself when a patient dies	3.52
Understand the role of regulatory bodies with respect to the safe use of radiation.	3.52
Apply knowledge of Bio-medical Sciences and technology to clinical practice	3.51
Enter and record patient's details and examinations requested	3.51
Use information technology effectively	3.51
Assist with hystero-salpingo grams	3.51
Perform basic Quality Control tasks (x-ray machine and processor QC)	3.5
Prioritise daily workload	3.49
Maintain a film processor e.g. cleaning and replenishing of a wet processor.	3.49
Assess trauma patient's injuries by taking a brief clinical history and correlating this with the request form	3.47
Make patient appointments	3.47

Retrieve films and reports	3.47
Organise daily work schedule	3.47
Position the patient correctly for non-routine radiographic positions	3.44
Draw up iodine based contrast media	3.44
Apply knowledge of radiobiology to clinical practice for the purpose of radiation safety.	3.44
Assist the radiologist with specialised paediatric procedures such as fluoroscopy, angiography and interventional radiology.	3.44
Perform routine (all plain film views) paediatric radiography examinations	3.42
Be aware of the cost of radiography equipment and accessories	3.41
Solve radiography related problems	3.41
Assist the radiologist with barium enema investigations	3.4
Perform cardio-pulmonary resuscitation in a first aid capacity.	3.38
Assist the radiologist with barium swallow investigations	3.33
Assist the radiologist with small bowel enema investigations	3.33
Manage resources effectively	3.31
Assist the radiologist with barium meal investigations	3.3
Discuss techniques with referring clinicians	3.3
Well versed in HIV and AIDS in order to understand the patient's situation and needs.	3.27
Perform Interventional Radiography (assisting the radiologist with all vascular exams)	3.23
Effectively present information technology	3.18
Supervise student radiographers	3.12
Report on Accident and Emergency plain film radiography (Red Dot System)	3.1
Set up and monitor a reject analysis program	3.1
Monitor patient's BP and ECG monitors and ventilators to know when to seek medical assistance	3.07
The ability to communicate with patients in their mother tongue where possible.	3.07
Be able to debate issues related to health care	3.04
Deal with the relatives of a patient who has died	3.02
Correctly store, manipulate and retrieve digital images	3
Perform basic/routine dental radiography examinations (intra-oral/peri-apical)	2.98
Provide a verbal report to the referring clinician on pattern recognition in general radiography (not make a diagnosis)	2.95
Teach and advise peers	2.94
Conduct forensic radiography	2.92
The ability to communicate with the referring clinician on matters relating to the emotional well being of the patient.	2.85
Able to conduct tutorials for CPD	2.83
Conduct a research project	2.73
Be able to implement findings from other researchers into their practice	2.7
Perform Computerised Tomography investigations	2.6
Perform mammography investigations	2.58

Be able to critically evaluate relevant research in the field of radiography	2.4
The ability to devise a business plan for a radiography practice.	2.36
The ability to recognise when to refer a patient for emotional counselling.	2.2
Perform Magnetic Resonance investigations	1.98
Perform excretory urography independently without the assistance of a radiologist.	1.93
Provide a written report to the referring clinician on pattern recognition in general radiography (not make a diagnosis)	1.85
Perform basic obstetric ultrasound (excluding doppler)	1.83
Perform barium swallows independently without the assistance of a radiologist	1.8
Perform basic abdominal ultrasound scanning (excluding doppler)	1.8
Perform barium meals independently without the assistance of a radiologist	1.69
Perform small bowel enemas independently without the assistance of a radiologist	1.59
Administer intravenous contrast media	1.58
Perform barium enemas independently without the assistance of a radiologist	1.5

All the clinical competencies (in Table 4.17) depicting a mean score >3 were considered necessary competencies for newly qualified radiographers. The consensus of opinion on these clinical competencies resulting from this research compare well with international standards for registrants (Health Professions Council of the United Kingdom, 2003) and the ARRT (Cavallin, 2006). The clinical competencies which were ranked most highly relate specifically to the radiographer such as; position the patient correctly for routine radiographic projections, minimise radiation exposure to patients and the public and adapt technical factors to suit variations in the patient's condition. Generic competencies were also highly ranked such as; assure appropriate patient care, maintain and support patient confidentiality and work ethically. Clinical competencies in specialised imaging procedures such as Computerised Tomography, mammography and MRI also ranked low. Some competencies that obtained low ranks are competencies that are traditionally performed by radiologists such as; performing gastro-intestinal contrast media studies independently and administering intravenous

contrast media. The tendencies relating to ranking correlate well with the findings of a similar study by Edgren (2006).

The results have also highlighted the acceptance of the Critical Cross-field Outcomes for inclusion, namely;

- *Demonstrate computer literacy* in order to access and utilise the hospital record system,
- *Offer peer support and encouragement,*
- *Commitment to life-long learning,*
- *Use of information technology effectively,*
- *Effective presentation of information technology,*
- *Debate issues relating to health care,*
- *Reflect on own behaviour*

It is encouraging to note that there has been a slight shift with regards to the acceptance of clinical competencies with some degree of *role extension*, namely;

- *Assess the trauma patient's injuries by taking a brief clinical history and correlating this with the request form,*
- *Apply the Red Dot system to accident and emergency plain film,*
- *Discuss techniques with referring clinicians*

4.5.2 Areas of clinical practice not requiring competence

Areas of clinical practice in which newly qualified diagnostic radiographers only require *clinical exposure* and *not clinical competence* have also been identified (Table 4.18).

Table 4.18 Areas where clinical exposure is required, but not clinical competency.

Mammography
Computerised Axial tomography
Storage and manipulation of digital images

Again, this result compares with international standards (Health Professions Council of the United Kingdom, 2003; Cavallin, 2006). However storage and manipulation of digital images *is a pre-requisite* for radiography registrants in the UK. It is however important to note that the studies conducted by Akroyd and Wold (1996) and Kowalczyk and Mazal (2006) which investigated the workplace skills required of new graduates, revealed that radiography managers felt that the undergraduate clinical curriculum should develop the newly qualified radiographer so that they can, amongst other competencies, perform CT and utilize computers.

4.5.3 Clinical competencies, for newly qualified radiographers, on which consensus could not be reached

Clinical competencies on which consensus could *not* be reached as to whether required by a newly qualified radiographer have also been identified (Table 4.19).

Table 4.19 Clinical competencies *not* achieving consensus for newly qualified radiographers.

Conduct a forensic radiography examination
Be able to conduct a research project
Be able to critically evaluate relevant research in the field of radiography
Be able to implement findings from other researchers into their practice
Be able to devise a business plan for a radiography practice
Give a *verbal report* to the referring clinician on any abnormal appearances of general/plain radiographic images (not make a diagnosis-added for clarification)

Be able to communicate with the referring clinician on matters relating to the emotional well-being of the patient
Be able to conduct tutorials for CPD
Be able to recognise when to refer a patient for emotional counselling
Perform peri-apical/ intra-oral dental views

4.5.4 Clinical competencies for inclusion in the scope of practice

Clinical competencies for *inclusion into the scope of practice* with additional education were also identified (Figure 4.20).

Table 4.20 Clinical competencies, with additional education, for inclusion into the scope of practice

Comment *verbally* on accident and emergency plain film radiography
Perform Magnetic Resonance investigations

4.5.5 Clinical competencies not achieving consensus for inclusion in the scope of practice

Consensus could not be reached on whether the following clinical competencies should be included in the scope of practice of the diagnostic radiographer, even with additional education (Table 4.21):

Table 4.21 Clinical competencies not achieving consensus for inclusion in the scope of practice

Administer IV contrast media
Perform basic abdominal ultrasound (excluding Doppler)
Perform basic obstetric ultrasound (excluding Doppler)
Insert a needle into a vein in preparation for a IV injection
Insert a rectal tube in preparation for a barium enema
Comment *in writing* on accident and emergency plain film radiography
Perform all GIT contrast media studies independently in the absence of a radiologist or medical officer
Write a report on the above examination (in the absence of a radiologist or medical officer)
Perform an excretory urogram independently in the absence of a radiologist or medical officer (question re-phrased)
Write a report on the above examination (in the absence of a radiologist or medical officer)

All of the clinical competencies listed in Table 4.21 are considered as role extension competencies, traditionally undertaken by the radiologist or suitably qualified medical

officer. Currently in the UK, these examinations are undertaken by specially trained radiographers (Ward, 1998; White & McKay, 2002; Nightingale & Hogg, 2003).

4.5.6 Clinical competencies for *exclusion* from the scope of practice

The clinical competencies which should be *excluded from the scope of practice* of the radiographer were also identified (Table 4.22).

Table 4.22 Exclusions to the scope of practice of the radiographer

Give a *written report* to the referring clinician on any abnormal appearances of general/plain radiographic images (not make a diagnosis- added for clarification)

This result appears to relate directly to the legal implications of role development.

4.6 Summary of the differences between academics and clinical practitioners

This research identified clinical competencies in which there were statistically significant differences in the opinions of academics and clinical practitioners (Table 4.23).

Table 4.23 Clinical competencies with statistically significant differences of opinion between academics and practitioners.

Determining the need for additional projections
Reporting on pattern recognition in general radiography
Reporting on Accident and Emergency plain film radiography (Red Dot System)
Setting up and monitoring a reject analysis program
Performing basic Quality Control tasks (x-ray machine and processor QC)
Effectively present information technology
Adapting positioning to demonstrate specific pathology
Take remedial action if the radiographs are not of diagnostic quality
Liaise with nursing staff
Discuss techniques with referring clinicians
Enter and record patient's details and examinations requested
Organize the daily work schedule
Debate issues related to health care
Provide a written report in general radiography
Dealing with relatives of a patient who has died
Acknowledging when to seek emotional support for oneself
Understanding the role of the regulatory bodies with respect to the safe use of radiation
The ability to competently devise a business plan for a radiography practice
Communicating with the referring clinician on matters relating to the emotional well being of the patient

Understanding the patients needs with respect to HIV and AIDS
Computer literacy in order to access and utilize the hospital records system
Usage of instruments and drugs on the emergency trolley
Maintaining a film processor (wet processor)
Administering IV contrast media
Providing a written report to the referring clinician on any abnormal appearances in of general radiography
Writing a report on an independently performed EUG

These differences have highlighted the fact that the "intended curriculum" and "learned curriculum" [17] are not completely in alignment with one another.

4.7 Conclusion

The group communication process of the Delphi technique has revealed an "event" interaction (refer to Table 3.2) as described by Scheele (1975) which resulted in inflexible opinions as to what radiographers can and cannot do. This "event" type interaction is seen in the response to clinical competencies considered for role extension which produced a split in opinion (refer to Table 4.23). The reluctance of clinical practitioners to extend their roles appears to stem from a fear of the legal issues involved with increased accountability and responsibility. This is evident in the response of the panel which indicates willingness that radiographers provide a *verbal* report but not a *written* report. This response is somewhat supported by various authors on the legalities of role expansion (White & McKay, 2002; Hardy & Snaith, 2006; Hardy & Persaud, 2001). Literature supports the idea that role expansion of radiographers, which involves the adoption of roles previously undertaken by other Health Care Professionals, usually arises out of a need (White & McKay, 2002). Radiographers in South African need to take responsibility for career pathing by

[17] Based on the model of Remmen (in Moercke & Eika, 2002). See page 13.

exploring opportunities to extend their roles in the delivery of dynamic health care system and thereby develop their profession.

CHAPTER 5

EXPECTATIONS OF THE DIAGNOSTIC RADIOGRAPHER IN THE SOUTH AFRICAN CONTEXT

> As long as the beginner pilot, language learner, chess player, or driver is following rules, his performance is mediocre. But with the mastery of the activity comes the transformation of the skill which is like the transformation that occurs when a blind person learns to use a cane. The beginner feels pressure in the palm of his hand which is used to detect the presence of distant objects such as curbs. But with mastery the blind person no longer feels the pressure in the palm of the hand, but simply feels the curb. The cane has become an extension of the body (Dreyfus & Dreyfus in Benner, 2001: 33).

5.1 Introduction

In this final chapter, I will discuss how each of the research questions has been answered and provide a framework for the practice domains of the professional diagnostic radiographer in South Africa today and in the future. A new model of clinical performance,[18] which is based on the results of this research, is presented.

5.2 What is expected of new graduates in the workplace?

Consensus was reached on the clinical competencies required of newly qualified diagnostic radiographers in South Africa. The following are examples of these competencies;

- Apply knowledge of Bio-medical Sciences (Anatomy, Physiology, Radiation Science and Pathology) and technology to clinical practice
- Adapt positioning to suit variations in the patient's condition
- Identify and respond to changes in the patient's condition
- Monitor patient's blood pressure monitors, ECG monitors and ventilators in order to recognise when to seek appropriate assistance.

[18] See page 148

- Implement measures to prevent and control infection
- Maintain a film processor e.g. cleaning and replenishing of a wet processor.
- Perform basic Quality Control tasks (x-ray machine and processor QC)
- Organise daily work schedule
- Identify problems in the radiographic context
- Maintain and support patient confidentiality

Refer to Table 4.17, page 128 for the detailed list of the clinical competencies.

There are *similarities* between the standards of proficiency for radiographers in the United Kingdom (these are minimum standards for registration) (Table 2.1, page 20-22) and those resulting from this research (Table 4.17) namely that newly qualified radiographers should:

- Assist with fluoroscopy and complex contrast procedures;
- Assist with computerised tomography examinations (refer to Table 4.18, page 133)

Similarities can also be seen between the results of this research and the American Registry of Radiologic Technologist (ARRT) who also *exclude* a clinical competence in mammography and computerised axial tomography in their certification examinations because experience has proved that the newly qualified radiographer is not expected to be competent in these (Cavallin, 2006). Similarly, a clinical competency in MRI and mammography are not considered in the UK standards of proficiency for registration either. This supports the findings of this research because with reference to Table 4.19,

(page 133) consensus could not be reached as to whether the newly qualified radiographer should be clinically competent to perform mammography. The results of this research indicates that a clinical competency in MRI be restricted to post graduate studies (Table 4.20, page 134).

There are also some important *differences* between the UK standards of proficiency and the results of this research namely that; newly qualified radiographers are expected to:

- Be clinically competent in processing of computer based imaging systems (Table 2.1, page 21) in the UK, while in the South African context, consensus could not be reached (Table 4.19, page 126);
- Use research, reasoning and problem solving skills to determine appropriate actions (Table 2.1) in the UK, while in the South African context, this can be equated to Evidence-based practice which did not achieve consensus (Table 4.19, page 133);
- Be clinically competent to communicate information, advice, instruction and professional opinion to colleagues, patients, clients, users, their relatives and carers (Table 2.1) in the UK, while the results of this research indicate a lack of consensus on the similar clinical competencies for the South African context (Table 4.19).

In summary, these results typify the Dreyfus and Dreyfus model of skill acquisition (described in Benner, 2001) where the competent performer may typically be the final year student radiographer, who has worked in the similar or same clinical environment

for three years (typically the duration of the radiography programme) and possesses a sense of mastery and the ability to cope and manage. It would appear that the structure of the clinical curriculum for radiography does not allow students sufficient exposure to the clinical competencies where consensus was achieved that those competencies were not required by newly qualified radiographers (refer to Table 4.18 and 4.19). Their experiential learning related to these clinical competencies may only allow them an "advanced beginner" status where they have coped with sufficient real situations or had them pointed out by a mentor or clinical tutor. They are able to recognise the aspects of a situation because there is some contextualization. They are able to apply the rules or guidelines known by the novice but are unable to adapt to different situations.

The implications for teaching and learning are that those in this stage of skill acquisition need support in setting priorities and thus need to be "backed up" by a qualified radiographer in the clinical setting (Benner, 2001).

5.3 Is there a gap between the clinical curriculum and performance skills?

The results of the research reflect that there are statistically significant differences in the expectations of the academics and clinical practitioners. These differences relate to the model of competence of the new radiographer of Williams and Berry (1999) (Figure 2.7) [19] which seeks collaboration between the workplace, educational institutions and the statutory requirements.

There are clearly some clinical competences on which the academics and clinical practitioners differ, both in the *fitness of purpose* and *fitness of award.*

[19] Williams and Berry (1999) model, page 35.

Examples of *fitness of purpose* (the immediate requirements of the workplace) are;

- Determining the need for additional projections
- Taking remedial action if radiographs are not of diagnostic quality

Examples of *fitness of award* (the educational preparation of the radiographer) are;

- Understanding the patient's needs with respect to HIV and AIDS
- Acknowledging when to seek emotional support for oneself

Fitness for practice focuses on the legal aspects of the individual radiographer's capabilities and there was clearly divergent opinion in all of the clinical competencies incorporating some aspects of role extension. Academics were also more supportive of role extension possibilities than the clinical practitioners. Examples of these are;

- Reporting on Accident and Emergency plain film radiography (Red Dot System)
- Discussing techniques with the referring clinicians

For a more detailed list of the differences in opinions between academics and clinical practitioners, refer to Tables 4.23 and 5.1.

An analysis of these differences reveals that academics place greater emphasis on a competency in the CCFOs e.g. information technology. Academics also place greater importance on higher order cognition competencies e.g. taking remedial action, discussion of techniques and devising a business plan.

What is of concern though, is that there were statistically significant *differences* of opinion between academics and clinical practitioners on competencies which achieved *overall consensus* (numerical consensus i.e. mean scores > 3, however having significant variation in the academic and practitioner groups), (see Table 5.1 below).

Table 5.1 Clinical competencies achieving overall consensus for newly qualified radiographers on which academics and practitioners differ.

Competency
1. Apply knowledge of radiobiology to clinical practice for the purposes of radiation safety.
2. Be well versed in HIV and AIDS in order to understand the patient's situation and needs.
3. Be familiar with the instruments and drugs on the emergency trolley.
4. Apply the Red Dot System to accident and emergency plain film radiography.
5. Set up and monitor a reject analysis program.
6. Maintain a film processor.
7. Perform basic Quality Control tasks.
8. Effectively use and present information technology.
9. Deal with relatives of a deceased patient.
10. Acknowledge the need to seek emotional support for oneself in order to deal with death in a professional context.

These differences have immediate implications for the various facets of the clinical curriculum and thus affect the workplace preparedness of the new graduate. A forum for further collaboration between academics at the HEIs, clinical practitioners at the various clinical platforms and the statutory bodies needs to be investigated to better understand these differences.

The results also provide insight into the model adapted from Moercke and Eika (2002) (Figure 1.2)[20] which evaluates the clinical skills curriculum. The "intended curriculum" of the interim registered SAQA outcomes has been interpreted in a variety of ways as

[20] On page 13.

the results revealed instances where what was intended as a SAQA clinical outcome, did not achieve consensus by the panel as a competency required by the newly qualified radiographer. Examples of these are, a clinical competency in performing Forensic radiography as well as acquisition and storage of digital images. These differences will have implications for the "intended curriculum" and the "curriculum in action" as both academics and clinical practitioners are involved in the clinical teaching and thus the learning that occurs. There proved to be no statistically significant differences between clinical practitioners at various clinical platforms.

5.4 What are the implications of the clinical competencies identified for benchmarking undergraduate assessment practices?

With reference to the assessment of clinical practice, it would seem that those clinical competencies which achieved consensus (refer to Table 4.17) as being required by newly qualified radiographers (referred to as "Observable Practice" in the model of Melnick *et al.*, 2002, Figure 1.3), [21] be included in the assessment of clinical competence. Because radiography education has a large clinical component to the education of the student radiographer, most, if not all aspects of clinical competency should reach "clinical performance" status as the students practice in the 'real workplace' (refer to Table 5.1). The Cambridge model by Rethans *et al.*, (2002) (Figure 2.4) show this relationship between competence and performance. The "system related" influences for purposes of this research, have been interpreted as the different clinical platforms (i.e. state versus private practice, while the individual related influences are the attitudes and disposition of the students which is not part of this research). The

[21] Model of Melnick *et al.*, (2002) on page 13.

results of this research have revealed that the "system related" influences may not be statistically significant because a limitation of this result is that only five of the panel members of the final round were representing private practices.

It is necessary to restate the definitions below in order to understand the implications for assessment:

- *Clinical competence* is what the student is able to do at an expected level of achievement for example, at the end of the radiography qualification. These would be the clinical competencies identified in Table 4.17;
- *Clinical performance* is what the student actually does in real clinical practice (Newble, 1992). Newble (1992) makes a further distinction between these two concepts by suggesting that competence is a necessary prerequisite for performance in the real clinical setting. The definition of the *clinical performance skills* has been developed from Newble (1992) for purposes of this study.
- *Clinical performance skills* are those competencies needed by entry-level diagnostic radiographers to engage effectively in their workplace. These would be the clinical competencies identified in Table 4.17;
- *Competency based assessments* are measures of what individuals do in an assessment situation;
- *Performance based assessments* are defined as measures of what individuals do in practice under normal working conditions (Rethans *et al.*, 2002).

Ideally the clinical assessment of student radiographers should assess the "clinical performance skills" which are the clinical competencies in Table 4.17 in order to

prepare them for the workplace. Clinical educators should thus create an environment of clinical teaching that accurately reflects the workplace requirements. To create this environment, the students should be encouraged to develop a "deep" approach to clinical learning which should imitate clinical assessment practices (Biggs, 1999; Lambert & Lines, 2000).

Figure 5.1 represents the basis of the "Practice Domain" model of the diagnostic radiographer based on the results of this research. The *observed practice* encompasses the necessary clinical competencies of a newly qualified radiographer having been identified by a Delphi panel representing radiography in South Africa (refer to Table4.17).

In terms of the *potential practice,* which for purposes of this study, relates to role extension as described by White and Mc Kay (2002), there was consensus on technological advances (i.e. MRI) and one might say a leaning towards one aspect of adopting a role previously undertaken by a radiologist (refer to Table 4.20). In general though, consensus could not be reached on the *potential practice* of the radiographer (refer to Table 4.19, 4.21). Aspects of the *Professional field* have been identified (see Table 4.17), but consensus could not be reached on competencies which would move the profession forward such as Evidence Based Practice (EBP), Continuing Professional Development (CPD) and some attitudes relating to role development (refer to Table 4.19).

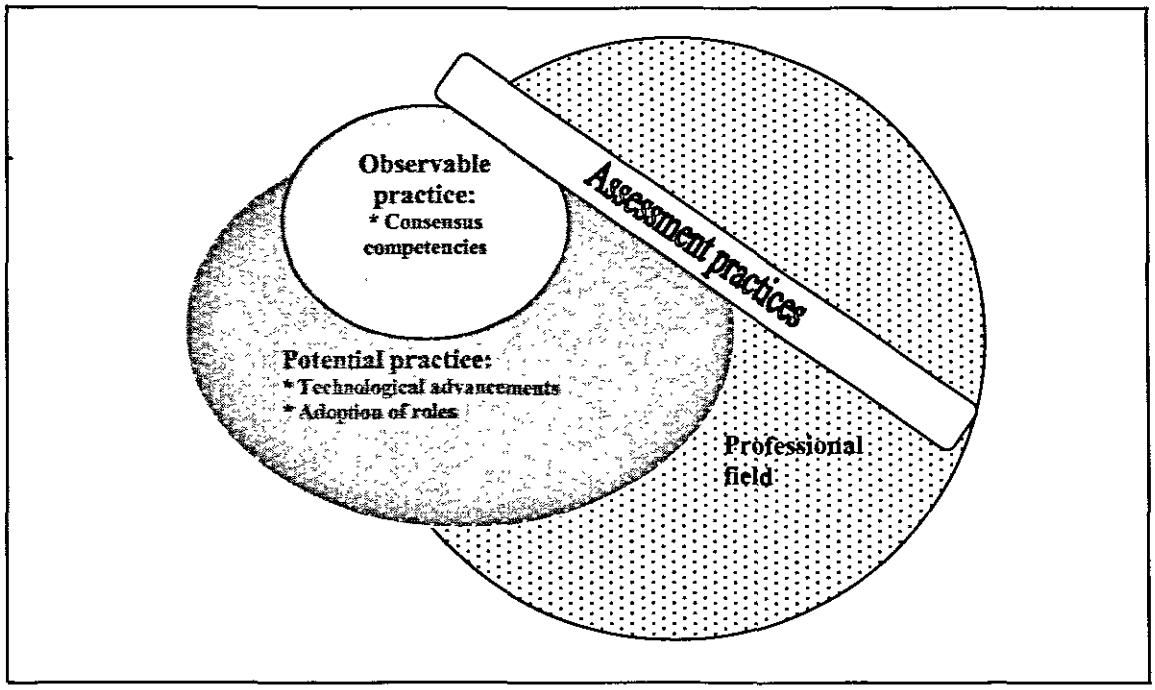

Figure 5.1: Practice Domains and Assessment Practices model for the South African context

5.5 A new model for clinical performance of radiographers

The competence versus performance model of Miller from Rethans *et al.*, (2002) has now been adapted to the results of this research as illustrated in Figure 5.2 below. Newble (1992) describes the acquisition of "clinical performance as "what the student actually does in real clinical practice in the workplace." The Davidson's model (2006) proposes that "clinical performance" as described by Newble (1992) be implemented into the student's learning using the following four steps:

1. A thorough theoretical knowledge;
2. An appropriate understanding of the relevant clinical applications of that theoretical knowledge;
3. Sufficient exposure and experience of the practical situations thereby allowing
4. An ability to perform competently in the clinical setting.

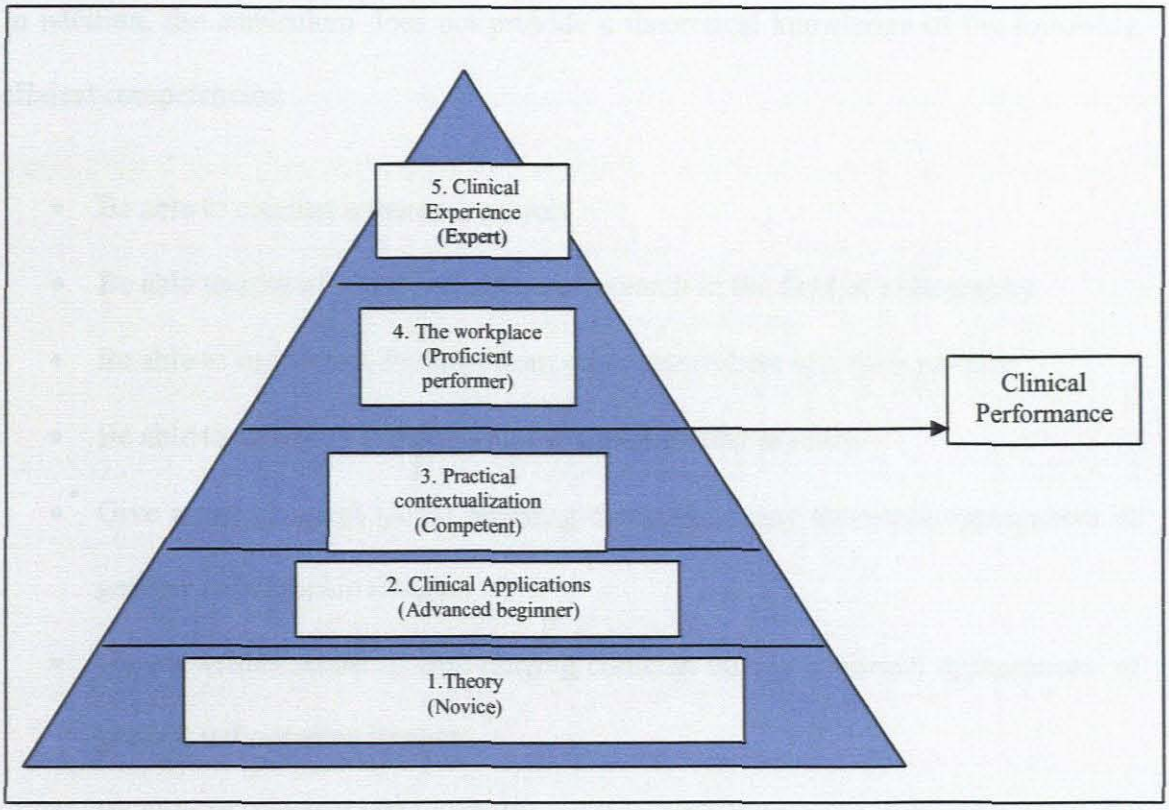

Figure 5.2 Davidson's (2006) model of clinical performance based on the models of Miller in Rethans *et al* .,(2002) and Dreyfus and Dreyfus in Benner (2001).

This model acknowledges that clinical expertise is likely to evolve, provided that there is adequate time to develop experience.

Miller's model from Rethans et al (2002) (Figure 2.3, page 28) indicates that "showing how" is an indication of competence. With reference to the results of this study, it would appear that in some situations radiography students are not getting sufficient clinical exposure to allow them a competence to:

- Perform mammography
- Operate a computerised tomography unit
- Correctly store, manipulate and retrieve digital images
- Conduct a forensic radiography examination

In addition, the curriculum does not provide a theoretical knowledge of the following clinical competencies:

- Be able to conduct a research project
- Be able to critically evaluate relevant research in the field of radiography
- Be able to implement findings from other researchers into their practice
- Be able to devise a business plan for a radiography practice
- Give a verbal report to the referring clinician on any abnormal appearances of general radiographic images
- Give a written report to the referring clinician on any abnormal appearances of general radiographic images
- Be able to communicate with the referring clinician on matters relating to the emotional well-being of the patient
- Be able to conduct tutorials for CPD
- Be able to recognize when to send a patient for emotional counselling
- Perform basic/routine dental radiography examinations (excluding panorex and zonarc)

Table 4.12 (page 110), according to Miller's model (Rethans *et al.*, 2002), indicates that there was consensus that the newly qualified radiographer should posses a "know how" about mammography, computerised tomography and digital imaging. Only a theoretical knowledge is required of the research process (i.e "knows" according to the Miller model).

5.6 Reflection

In summary, the "truthfulness" of the results of this communication process has content validity by virtue of the fact that a representative sample of experts was selected onto the panel. The stability of the responses from round two to three is a further indication of the reliability of the results. The reiteration and controlled feedback of the Delphi process has provided an effective forum for communication. This is evident from the development of consensus between the three rounds of questionnaires. The consensus of opinion of the clinical competencies required of newly qualified diagnostic radiographers in South Africa compares well with the published minimum standards of clinical proficiency for radiographers in the United Kingdom (Health Professions Council of the United Kingdom, 2003) and the American Registry of Radiologic Technologists (Cavallin, 2006). This result increases the reliability of the research. The same cannot be said for role extension (i.e. potential practice) possibilities. The results of this research indicate that South African radiographers are lagging behind their British counterparts in this regard.

This research is significant because the results can inform decision-making bodies such as the SGB for radiography. In September 2004, the radiography SGB agreed on a 480-credit professional degree for diagnostic radiography as well as a 240-credit early exit diploma. The motivation for the upgrading the radiography qualification to a professional degree was to bring it on par with other health care qualifications such as Physiotherapy. The purpose of the early exit was to address the need for a "mid-level worker" in the country (Health Professions Council of South Africa, 1c).

The aim of this research was to get national consensus on the clinical competency requirements of the newly qualified diagnostic radiographer in the South African context. The competencies identified must equip them for their professional roles presently and in the future (refer to the statement of aims in questionnaire 3, appendix I). The results of the research gave insight into the attitudes of a representative sample of radiographers with regard to possible role extension opportunities. This insight could be further researched in terms of where these role extension opportunities can fit into the new 480-credit professional degree. The results of this research can also inform the clinical competencies requirements of the mid-level worker (240-credit, early exit).

The need for further collaboration amongst the various stakeholders has also been highlighted to ensure a more realistic and truthful intended curriculum. Finally it is hoped that the topic under study will be of value to other HCPs wanting to conduct similar research.

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Appendix A

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OFFICE OF THE CHAIRPERSON: HEATH SCIENCE RESEARCH ETHICS COMMITTEE

At a meeting of the Health Science Research Ethics Ex-co Committee Meeting on 6 OCTOBER 2004, ethics approval was granted to Florence Davidson for research activities related to the M Tech (Radiography) degree at the Cape Peninsula University of Technology.

TITLE: The assessment of radiographic clinical practice

A title change was approved in March 2005

TITLE: Pre-liminary guidelines for defensible standards for the assessment of clinical performance in Diagnostic Radiography

Comment:

Research activities are restricted to teaching sites in the hospital environment, without involvement of patients.

MS PENELOPE ENGEL-HILLS

CHAIRPERSON: HEATH SCIENCE RESEARCH ETHICS COMMITTEE

e-mail: winbergc@pentech.ac.za Website: http://www.pentech.ac.za

Appendix B

CAPE PENINSULA UNIVERSITY OF TECHNOLOGY

Cape Town Campus
P O Box 652
CAPE TOWN 8000

Bellville Campus
P O Box 1906
BELLVILLE 7535

DEPARTMENT OF HEALTH SCIENCES: RADIOGRAPHY
(Groote Schuur Hospital Campus)

Contact details:
Polly (Florence) Davidson (Researcher)
Phone: 021 442 6172
Fax: 021 447 2963
Cell: 082 2020628
davidsonf@cput.ac.za

29th June 2005

Dear

Invitation to participate in a research study towards a Masters Degree in Radiography

I am studying towards a Masters Degree in Radiography. The title of the research is: "Pre-liminary guidelines for defensible standards for the assessment of clinical performance in Diagnostic Radiography". The main objective of this study is to gain consensus nationally from radiography educators and practitioners on the skills required by entry-level Diagnostic radiographers.

The potential benefit of this study is better alignment between clinical assessment practices and professional preparation for entry-level radiographers.

Participants will be invited nationally from all educational institutions offering the diagnostic radiography qualification. The study will be conducted using the Delphi Technique which employs the use of a panel of "experts" to participate (by way of a reaction to the items listed and generated by others on the skills required by entry-level radiographers) in a series of rounds between which a summary of the results of the previous round is communicated to and evaluated by panel members. I will correspond with participants in writing, using sequential questionnaires interspersed with

summarized information. I will attempt to systematically produce consensus of opinion and to identify opinion divergence. There will be anonymity amongst panel members and the opinions of the panel will remain confidential. There will be a process of iteration and controlled feedback.

If you agree to participate in the study, please sign the consent form below and return it in the envelope provided. I further need your assistance in providing me with the names three or more practitioners from the clinical platforms who are involved in the clinical education and supervision of newly qualified diagnostic radiographers so that I may invite them to participate in the study. (See appendix A).

If you have any questions about the study or about participating in the study, please feel free to contact me.

The Cape Peninsula University of Technology Ethics Committee has approved the study and procedures. (See attached copy).

Yours sincerely

FE DAVIDSON (Diagnostic Radiography Lecturer)

Appendix B1

PARTICIPANT CONSENT

STUDY TITLE: **Pre-liminary guidelines for defensible standards for the assessment of clinical performance in Diagnostic Radiography.**

RESEARCHER: **Florence Davidson, Diagnostic Radiography Lecturer, Cape Peninsula University of Technology (formerly Peninsula Technikon), Groote Schuur Hospital Satellite Campus.**

Contact details:

Phone: 021 442 6172

Fax: 021 447 2963

Cell: 082 2020628

davidsonf@cput.ac.za

I, (full name)_____ consent to participate in the research study.

I understand that:

1. **My participation is voluntary.**
2. **I have the right to withdraw at any time without consequence.**
3. **I will be asked to give opinions on issues related to the research and that these opinions will not result in any judgement of me.**
4. **I may be asked to provide written justification for my response for purposes of clarity.**
5. **I will be kept informed of the results of each round of the questionnaire.**
6. **Anonymity amongst panel members is assured.**
7. **Confidentiality of all data gathered will be maintained during the analysis of the research.**

Signature of participant: _____

Position: _____

Date: _____

Institution: _____

Appendix C

Name	Position held	Email address	Business Address	Telephone number and area code

Appendix D

CAPE PENINSULA UNIVERSITY OF TECHNOLOGY

Cape Town Campus
P O Box 652
CAPE TOWN 8000

Bellville Campus
P O Box 1906
BELLVILLE 7535

DEPARTMENT OF HEALTH SCIENCES: RADIOGRAPHY
(Groote Schuur Hospital Campus)

Contact details:
Polly (Florence) Davidson (Researcher)
Phone: 021 442 6172
Fax: 021 447 2963
Cell: 082 2020628
davidsonf@cput.ac.za

6th June 2005

Dear Participant

Re: Participation in a research study towards a Masters Degree in Radiography

Thank you for agreeing to serve on the panel of experts for my study entitled: "Preliminary guidelines for defensible standards for the assessment of clinical performance in Diagnostic Radiography". Your expert opinion is greatly valued.

The main objective of this study is to gain consensus nationally from radiography educators and practitioners on the skills required by entry-level Diagnostic radiographers. The potential benefit of this study is better alignment between clinical assessment practices and professional preparation for entry-level radiographers.

The design of this study is such that there are three rounds of questionnaires, namely:

- The first round questionnaire asks you to rank your agreement/disagreement with a list of clinical skills required by newly qualified diagnostic radiographers.

- The second round questionnaire is based on the responses from the first round and will only include items/issues on which consensus was not reached.
- The third round of the questionnaire will further aim to get clarity on any items/issues from the second round and any additional input.

Your participation in the first round questionnaire involves the following:

1. Signing the attached consent form and faxing it to the above number.
2. Completing section A which is your biographical details.
3. Completing section B of the attached questionnaire which entails ranking your agreement/disagreement with the list of clinical skills required by newly qualified diagnostic radiographers. A four point Lickert scale is provided for your ranking. There is no provision for a neutral response.
4. Providing any additional skills that you think are necessary.

It should take you approximately 30 minutes to complete the questionnaire.

Please confirm receipt of the questionnaire and return the completed questionnaire electronically by _____ to davidsonf@cput.ac.za to allow for timeous data analysis in preparation for the second round questionnaire.

Thank you once again for your time taken and effort to complete the questionnaire. If you have any queries, please contact me via email or telephone (021 442 6172).

Yours sincerely

FE DAVIDSON (Diagnostic Radiography Lecturer)

PARTICIPANT CONSENT

STUDY TITLE: Pre-liminary guidelines for defensible standards for the assessment of clinical performance in Diagnostic Radiography.

RESEARCHER: Florence Davidson, Diagnostic Radiography Lecturer, Cape Peninsula University of Technology (formerly Peninsula Technikon), Groote Schuur Hospital Satellite Campus.

Contact details:

Phone: 021 442 6172

Fax: 021 447 2963

Cell: 082 2020628

davidsonf@cput.ac.za

I, (full name)_____ consent to participate in the research study.

I understand that:

0. My participation is voluntary.
1. I have the right to withdraw at any time without consequence.
2. I will be asked to give opinions on issues related to the research and that these opinions will not result in any judgement of me.
3. I may be asked to provide written justification for my response for purposes of clarity.
4. I will be kept informed of the results of each round of the questionnaire.
5. Anonymity amongst panel members is assured.
6. Confidentiality of all data gathered will be maintained during the analysis of the research.

Signature of participant: _____

Position: _____

Date: _____

Institution: _____

Appendix E

QUESTIONNAIRE FOR THE DELPHI, ROUND 1

IDENTIFYING THE CLINICAL COMPETENCIES REQUIRED BY NEWLY QUALIFIED DIAGNOSTIC RADIOGRAPHERS IN SOUTH AFRICA

Thank you for assisting me with this research. Please read all the questions and place a cross or write in the appropriate box. Please enter one letter or figure per block.Please answer all the questions.

SECTION A: DEMOGRAPHIC INFORMATION OF RESPONDENT

A1 Name	
A2 Gender	
A3 Age	
A4 Year of Diagnostic Radiography Qualification	
A5 Place of employment	

A6 What is the nature of your current employment? Please place a cross in all the relevant options

	YES	NO
1 Full time radiographer in clinical practice		
2 Full time academic appointment		
3 Joint appointment – clinical and academic		
4 Radiography Manager in a clinical department		
5 Other (please specify)		

A7 Please indicate your **highest** Radiography and/or highest Radiography Education qualification

National Diploma	
National Higher Diploma	
B Tech Degree (Radiography)	
B Rad Degree	
M Tech (Radiography)	
D Tech (Radiography)	
B Tech Degree (Education)	
Higher Degree (Teaching Radiography)	
M Tech (Radiography Education)	
D Tech (Radiography Education)	
Other (please specify)	

A8 Please indicate your expertise in **diagnostic** radiography.
Please tick all the relevant options

	YES	NO
1 Undergraduate clinical education		
2 Postgraduate clinical education		
3 Clinical Supervision of new graduates		
4 Education expert		
5 Other (please specify)		

SECTION B: IDENTIFYING CLINICAL SKILLS REQUIRED BY NEWLY QUALIFIED DIAGNOSTIC RADIOGRAPHERS IN SOUTH AFRICA

This questionnaire deals with identifying the **clinical** skills required by a **newly qualified** diagnostic radiographer (within 3 months of qualifying).

Please rank your agreement/disagreement with each statement by placing a cross in the box. Please add any comments where necessary.
KEY: SD=Strongly disagree; D=Disagree; A=Agree; SA=Strongly Agree

	Ranking (Place a cross)				Brief Comments
B1 Technical skills and Theoretical applications	**SD**	**D**	**A**	**SA**	
1 Apply knowledge of Bio-medical Sciences and technology to clinical practice					
2 Operate equipment safely and efficiently					
3 Position the patient correctly for routine radiographic projections.					
4 Position the patient correctly for non-routine radiographic projections					
5 Correctly select technical factors					
6 Adapt positioning to suit variations in the patient's condition					
7 Adapt positioning to demonstrate specific pathology					
8 Adapt technical factors to suit variations in the patient's condition					
9 Determine the need for additional projections					
10 Recognise an appropriate standard of image quality (critically evaluate radiographs)					
11 Take remedial action if radiographs are not of diagnostic quality					
12 Perform independently in general radiography					
13 Perform with low repeats					
14 Process radiographic images					
15 Prepare contrast media					
16 Perform mammography investigations					
17 Perform Computerised Tomography investigations					
18 Perform Magnetic Resonance investigations					
19 Perform Interventional Radiography investigations					
20 Perform routine paediatric radiography examinations					

	SD	D	A	SA	Brief Comments
21 Correctly store, manipulate and retrieve digital images					
22 Perform Barium swallow investigations					
23 Perform Barium meal investigations					
24 Perform Small bowel enema investigations					
25 Perform Barium enema investigations					
26 Administer intravenous contrast media					
27 Perform basic abdominal ultrasound scanning (excl. Doppler)					
28 Perform basic obstetric ultrasound scanning (excl. Doppler)					
29 Report on pattern recognition in general radiography					
30 Report on Accident and Emergency plain film radiography (Red Dot System)					
31 Assess trauma patient's injuries					
32 Conduct forensic radiography					
33 Perform theatre radiography					
B2 Patient Care and Communication					
1 Communicate effectively with patients					
2 Assure appropriate patient care					
3 Identify and respond to changes in the patient's condition					
4 Communicate effectively with the patient's relatives					
6 Monitor patient's medical equipment					
7 Liaise with nursing staff					
8 Discuss techniques with referring clinicians					
9 Display appropriate interpersonal skills					
B3 Health and Safety					
1 Minimise radiation exposure to patients and public					
2 Minimise occupational exposure					
3 Implement measures to prevent and control infection					
4 Follow procedures for reporting any lapses in health and safety regulations					
B4 Management					
1 Set up and monitor a reject analysis program					
2 Perform basic Quality Control tasks (x-ray machine and processor QC)					

	SD	D	A	SA	Brief Comments
3 Liaise with all categories of staff					
4 Manage resources effectively					
5 Be aware of the cost of radiography equipment and accessories					
6 Work with an appreciation for cost					
B5 Organisation and Administration					
1 Make patient appointments					
2 Complete and check clinical request forms					
3 Retrieve films and reports					
4 Enter and record patient's details and examinations requested					
5 Organise daily work schedule					
6 Prioritise daily workload					
B6 Professional skills					
1 Conduct research					
2 Integrate research into practice (Evidence- based practice)					
3 Teach and advise peers					
4 Supervise student radiographers					
5 Work ethically					
6 Work effectively in a team with all categories of professional and support staff					
7 Identify problems in the radiographic context					
8 Solve radiography related problems					
9 Recognise the scope of practice of the radiographer					
10 Work within the scope of practice of the radiographer					
11 Offer peer support and encouragement					
12 Be committed to life-long learning					
13 Be able to adapt to varied work environments					
14 Willingness to work flexible hours					
15 Able to work in high stress environments e.g. trauma resuscitation room					
16 Able to cope with "on call" duties					
17 Use information technology effectively					
18 Effectively present information technology					
19 Be able to debate issues related to health care					
20 Communicate effectively verbally and in writing with others in the health care team					
21 Recognise own area of responsibility					

	SD	D	A	SA	Brief Comments
22 Able to self evaluate and reflect on behaviour					
23 Take responsibility for own actions					
24 Use own initiative					
25 Identify situations which require advice from senior staff					
26 Appreciate the need to be accountable					
27 Maintain and support patient confidentiality					
28 Recognise the lines of responsibility within the department					
29 Coping with death					
30 Coping with the trauma patient					
31 Resolving conflict					
32 Listening skills					

Please list any additional skills and further commentary that you feel is necessary.

Skill	Comment

Appendix F

CAPE PENINSULA UNIVERSITY OF TECHNOLOGY

Cape Town Campus
P O Box 652
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Bellville Campu
P O Box 1906
BELLVILLE 753

Article I. DEPARTMENT OF HEALTH SCIENCES (Bellville Campus)
(Environmental Health, Nursing, Biomedical Technology & Radiography)

Phone: 021 442 6172
082 2020 628
Email: davidsonf@cput.ac.za

24th October 2005

Dear Panel member

Attached is round 2 of the Delphi questionnaire.

Round 2 follows an analysis of round 1. The analysis yielded the following four categories which formed the structure of the questionnaire:

1. Clarification of terminology used in round 1.
2. Additional skills that emerged from round 1
3. Clinical skills that were identified as not being required by new graduates.
4. Clinical skills on which consensus could not be reached.

Please complete the five pages of round 2 by **18th November 2005** and return it in the self-addressed envelope provided.

I look forward to receiving your replies. Thank you once again for your valuable input.

Regards

Florence Davidson

Appendix G

QUESTIONNAIRE FOR THE DELPHI, ROUND 2

IDENTIFYING THE CLINICAL COMPETENCIES REQUIRED BY NEWLY QUALIFIED DIAGNOSTIC RADIOGRAPHERS IN SOUTH AFRICA

Thank you for participating in the second round of this research project. Please read all the questions and place a cross or write in the appropriate box. Please answer all the questions.

SECTION A: DEMOGRAPHIC INFORMATION OF RESPONDENT

A1 Name	
A2 Gender	
A3 Age	
A4 Year of Diagnostic Radiography Qualification	
A5 Place of employment	

A6 Please indicate your expertise in **diagnostic** radiography.
Please tick all the relevant options

	YES	NO
1 Undergraduate clinical education		
2 Postgraduate clinical education		
3 Clinical Supervision of new graduates		
4 Full time academic educationalist		
5 Other (please specify)		

SECTION B1: *In this section, I am trying to get clarity on the terminology used to describe* the clinical comptencies required by newly qualified diagnostic radiographers (within 3 months of qualifying).

PLEASE READ ALL THE QUESTIONS BELOW BEFORE RANKING YOUR RESPONSE.

KEY: SD=Strongly disagree; D=Disagree; A=Agree; SA=Strongly Agree

	Ranking				
Clinical competency	**SD**	**D**	**A**	**SA**	**Comments**
1. Application of knowledge of Bio-medical sciences refers to application of Anatomy, Physiology, Radiation Science and Pathology to clinical practice.					
2. Performing a barium swallow means:					
2.1 assisting the radiologist.					
2.2 without the assistance of a radiologist.					
3. Performing a barium meal means:					

Clinical competency	SD	D	A	SA	Comments
3.1 assisting the radiologist.					
3.2 without the assistance of a radiologist.					
4. Performing a small bowel enema means:					
4.1 assisting the radiologist.					
4.2 without the assistance of a radiologist.					
5. Performing a barium enema means					
5.1 assisting the radiologist.					
5.2 *without the assistance of a radiologist.*					
6. Report on pattern recognition in general radiography means:					
6.1 to provide a verbal report to the referring clinician.					
6.2 to provide a written report to the referring clinician.					
7. Monitor the patient's medical equipment refers to					
7.1 vigilance with regard to; IV infusions, oxygen supply and urinary catheters, in order to recognize when to seek *appropriate assistance.*					
7.2 vigilance with regard to; blood pressure monitors, ECG monitors and ventilators in order to recognize when to seek appropriate assistance.					
8. Prepare contrast media refers to: mixing barium sulphate preparations and drawing up of iodine-based contrast media for intravenous injection.					
9. Coping with death refers to:					
9.1 *following correct procedures if the patient dies in the* x-ray room.					
9.2 dealing with relatives who may be accompanying the patient.					
9.3 acknowledging the need to seek emotional support for oneself.					
10. Resolving conflict refers to using diplomacy to initiate discussion in a professional context.					
11. Routine paediatric radiography *refers to all plain* film radiography views (excluding contrast media studies and invasive studies e.g. interventional radiology).					
12. Performing interventional radiography refers to assisting the radiologist with all vascular work e.g. cardiac studies, hepato-biliary studies and general angiography.					
13. Assess the trauma patient's injuries refers to *taking a brief clinical history and correlating this with the* request form.					

Additional comments: If you feel strongly about any of the above, please record the number of the competency and comment:

SECTION B2: In this section, additional clinical competencies that emerged from the 1st round are recorded for your rating.

PLEASE READ ALL THE QUESTIONS BEFORE ANSWERING.

KEY: SD=Strongly disagree; D=Disagree; A=Agree; SA=Strongly Agree

	Ranking				
Clinical competency	**SD**	**D**	**A**	**SA**	**Comments**
1. Apply knowledge of radiobiology to clinical practice for the purpose of radiation safety.					
2. Understand the role of regulatory bodies with respect to the safe use of radiation.					
3. The ability to communicate with patients in their mother tongue where possible.					
4. The ability to devise a business plan for a radiography practice.					
6. The ability to recognize when to refer a patient for emotional counseling.					
7. The ability to communicate with the referring clinician on matters relating to the emotional well being of the patient.					
8.Well versed in HIV and AIDS in order to understand the patient's situation and needs.					
9. Knowing how to protect oneself professionally from HIV/AIDS.					
10. Perform accident and emergency radiography independently.					
11. Adapt radiography techniques to the trauma patient's injuries.					
12. Perform excretory urography with the assistance of a radiologist.					
13. Perform excretory urography **independently without the assistance of a radiologist.**					
15. Assist with hystero-salpingo grams					
16. Assist the radiologist with specialized paediatric procedures such as fluoroscopy, angiography and interventional radiology.					
16. Demonstrate computer literacy in order to access and utilize the hospital record system.					
17. Perform basic/routine dental radiography examinations.					
18. Perform basic first aid.					
19. Perform cardio-pulmonary resuscitation in a first aid capacity.					
20. Be familiar with the instruments and drugs on the emergency trolley.					
21. Observe the patient for signs of adverse reactions to contrast media.					
22. Maintain a film processor e.g. cleaning and replenishing of a wet processor.					

Additional comments: If you feel strongly about any of the above, please record the number of the competency and comment:

SECTION B3: There was consensus that the following <u>are not clinical competencies</u> required by newly qualified radiographers (within 3 months of qualifying). Please state whether these competencies should be part of the SCOPE OF PRACTICE of the radiographer.

PLEASE READ ALL THE QUESTIONS BELOW BEFORE RANKING YOUR RESPONSE.

KEY: SD=Strongly disagree; D=Disagree; A=Agree; SA=Strongly Agree

Statement	Clinical competency	SD	D	A	SA
These clinical skills should be in the SCOPE OF EXTENDED PRACTICE with <u>additional education.</u>	B3.1.Perform magnetic resonance investigations.				
	2. Administer intravenous contrast media.				
	3.Perform basic abdominal ultrasound (excluding Doppler).				
	4.Perform basic obstetric ultrasound (excluding Doppler).				

Additional comments: If you feel strongly about any of the above, please record the number of the competency and comment:

SECTION B4: Consensus was not reached on the following clinical competencies. Please rank your response.

PLEASE READ ALL THE QUESTIONS BELOW BEFORE RANKING YOUR RESPONSE.

KEY: SD=Strongly disagree; D=Disagree; A=Agree; SA=Strongly Agree

Clinical competency		SD	D	A	SA
1. Perform mammography investigations	1.Graduates should only have theoretical knowledge of mammography				
	2. Graduates should receive practical education in mammography.				
	3. This should be an elective module				
	2. Graduates should receive practical education in Computerised Tomography				
	3. This should be an elective module				
	2. Graduates should receive practical education on the acquisition, storage and manipulation of digital images.				
	3. This should be an elective module.				
2. Conduct forensic radiography	1. Graduates should only have theoretical knowledge of forensic radiography				
	2. Graduates should receive practical education in forensic radiography				
	3. This should be an elective module.				
3. Conduct research	Graduates should have theoretical knowledge on the research process.				
	2. Graduates should be able to conduct a research project.				
	3. This should be an elective module.				
4. Integrate research into practice (Evidence-based practice)	1. Graduates should be able to critically evaluate relevant research in the field of radiography.				
	2. Graduates should be able to implement findings from other researchers into their practice.				
	3. This should be an elective module.				
5. Teach and advise peers.	1. Graduates should be able to conduct tutorials for CPD.				

Please note that there are other clinical competencies on which consensus was not reached, however the clarity of the terminology used to describe these competencies needs to be determined first (see section B1). There will be opportunity in the third and final round for you to give your input on these competencies.

Additional comments: If you feel strongly about any of the above, please record the number of the competency and comment:

Appendix H

8th May 2006

Dear Panel member

Enclosed is the 3rd round questionnaire of the Delphi research. Thank you for your valuable input thus far. Please complete the questionnaire and return it to me in the self-addressed envelope by the 9th June 2006.

Regards

Polly Davidson
Email: davidsonf@cput.ac.za
Phone: 021 442 6172
082 2020 628
Fax: 021 447 2963

Appendix I

QUESTIONNAIRE FOR THE DELPHI, ROUND 3

IDENTIFYING THE CLINICAL COMPETENCIES REQUIRED BY NEWLY QUALIFIED DIAGNOSTIC RADIOGRAPHERS IN SOUTH AFRICA

Thank you for participating in the THIRD round of this research project. Please read all the questions and place a cross or write in the appropriate box. Please answer all the questions.

SECTION A: DEMOGRAPHIC INFORMATION OF RESPONDENT

A1 Name	
A2 Gender	
A3 Age	
A4 Year of Diagnostic Radiography Qualification	
A5 Radiography qualification type, e.g. Diploma, Degree etc.	
A6 Place of employment	

A6 Please indicate your expertise in **diagnostic** radiography.
Please tick all the relevant options

	YES	NO
1 Undergraduate clinical education		
2 Postgraduate clinical education		
3 Clinical Supervision of new graduates		
4 Full time academic educationalist		
5 Radiographer in clinical department		
5 Other (please specify)		

NB: This research aims to identify the minimum clinical competencies required of newly qualified diagnostic radiographers in South Africa. These competencies must prepare them for professional practice presently and in the future. The list of clinical competencies generated is to a large extent based on the interim SAQA registration for the 3-year National Diploma. Role extension possibilities within the profession and your professional opinion reflected in the first two rounds of the Delphi process were also considered. The completion of this round is intended to reflect the clinical competencies required for the endpoint of the qualification (presently a 3-year National Diploma and not any early exit) of the professional radiographer. The discussion on the findings of this research is intended to inform undergraduate clinical assessment practices.

SECTION B1: There was confusion in round 2 regarding the clinical competencies stated below. Items have been re-phrased. Please confirm your opinion.

PLEASE READ ALL THE QUESTIONS BELOW BEFORE RANKING YOUR RESPONSE.

KEY: SD=Strongly disagree; D=Disagree; A=Agree; SA=Strongly Agree

The newly qualified diagnostic radiographer (within 3 months of qualifying) should be clinically competent to:	**SD**	**D**	**A**	**SA**
1. Perform a mammogram				
2. Operate a Computerised Tomography unit				
3. Correctly store, manipulate and retrieve digital images				
4. Conduct a forensic radiography examination				
5. Mix barium sulphate preparations				
6. Draw up iodine-based contrast media for IV injection				

SECTION B2: Consensus was not reached in round 2 as to whether these clinical competencies are necessary in the *newly qualified diagnostic radiographer.* Please review your opinion in the space provided under the figure reflecting the percentages of the round 2 results.

PLEASE READ ALL THE QUESTIONS BELOW BEFORE RANKING YOUR RESPONSE.

KEY: SD=Strongly disagree; D=Disagree; A=Agree; SA=Strongly Agree

	SD	**D**	**A**	**SA**
The newly qualified diagnostic radiographer (within 3 months of qualifying) should:				
1. Be able to conduct a research project	2	27	47	24
2. Be able to critically evaluate relevant research in the field of radiography	9	27	40	24
3. Be able to implement findings from other researchers into their practice	10	15	56	20
4. Be able to devise a business plan for a radiography practice	14	39	39	9
5. Give a **verbal report** to the referring clinician on any abnormal appearances of general/plain radiographic images (not make a diagnosis-added for clarification)	10	18	40	33
6. Give a **written report** to the referring clinician on any abnormal appearances of general/plain radiographic images (not make a diagnosis-added for clarification)	40	20	23	18
7. Be able to communicate with the referring clinician on matters relating to the emotional well-being of the patient	16	24	53	7
8. Be able to conduct tutorials for CPD	2	18	64	16
9. Be able to recognize when to refer a patient for emotional counselling	18	45	34	2

	SD	D	A	SA
10. Perform basic/routine dental radiography examinations (refers to peri-apical/ intra-oral views- added for clarification)	4	22	38	36
11. Apply the Red Dot system to accident and emergency plain film (carried over from round 1)	12	18	47	22

SECTION B3: Consensus was not reached as to whether these clinical competencies should be part of *the scope of practice* of diagnostic radiographer (with additional education). Some *additional suggestions* were also made. Please review your opinion in the space provided under the figure reflecting the percentages of the round 2 results.

PLEASE READ ALL THE QUESTIONS BELOW BEFORE RANKING YOUR RESPONSE.

KEY: SD=Strongly disagree; D=Disagree; A=Agree; SA=Strongly Agree

Clinical competency:	**SD**	**D**	**A**	**SA**
1. Administer IV contrast media	11	27	27	36
2. Perform basic abdominal ultrasound (excluding Doppler)	11	16	42	31
3. Perform basic obstetric ultrasound (excluding Doppler)	11	20	33	36
4. Insert a needle into a vein in preparation for a IV injection (additional suggestion from round 2)				
5. Insert a rectal tube in preparation for a barium enema (additional suggestion from round 2)				
6. Comment **verbally** on accident and emergency plain film radiography				
7. Comment **in writing** on accident and emergency plain film radiography				

SECTION B4: There was consensus that the following are *not clinical competencies required by newly qualified* diagnostic radiographers (within 3 months of qualifying). Rate whether you think they should, *in the future, be included in the scope* of practice of the radiographer (with additional education).

PLEASE READ ALL THE QUESTIONS BELOW BEFORE RANKING YOUR RESPONSE.

KEY: SD=Strongly disagree; D=Disagree; A=Agree; SA=Strongly Agree

The following clinical competencies should be incorporated into the scope of practice of the diagnostic radiographer *with additional education:*	**SD**	**D**	**A**	**SA**
1. Perform all GIT contrast media studies independently in the absence of a radiologist or medical officer (question re-phrased)				
2 Write a report on the above examination (in the absence of a radiologist or medical officer)				
3. Perform an excretory urogram independently in the absence of a radiologist or medical officer (question re-phrased)				
4. Write a report on the above examination (in the absence of a radiologist or medical officer)				

SECTION C: DO YOU HAVE ANY FINAL COMMENTS?

Appendix J

Definitions of terms and concepts used in this thesis.

Standards	The aim or overall statement on clinical assessment practices with respect to validity and reliability (Hays, Miller, Booth, Harris, B, Harris, M & Stirton, 1998).
Clinical competence	What the student is able to do at an expected level of achievement for example, at the end of the radiography qualification.
Clinical performance	What the student actually does in real clinical practice (Newble 1992). Newble (1992) makes a further distinction between these two concepts by suggesting that competence is a necessary prerequisite for performance in the real clinical setting.
Clinical performance skills	Those competencies needed by entry-level diagnostic radiographers to engage effectively in their workplace (developed from Newble, 1992 for purposes of this research).
Competency based assessments	Measures of what individuals do in an assessment situation.
Performance based assessments	Measures of what individuals do in practice under normal working conditions (Rethans, Norcini, Baron-Maldonado, Blackmore, Jolly & LaDuca, 2002).
Entry-level radiographers	Newly qualified radiographers with a maximum of three months working experience (Williams & Berry, 1999).
Applied competence	The ability to put into practice in the relevant context the learning outcomes acquired in obtaining a qualification (Du Prè, 2000).
Exit level outcomes	The outcomes to be achieved by a qualifying learner at the point at which he or she leaves the programme leading to a qualification (Du Prè, 2000).